The American Journal of Surgery

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October 1951

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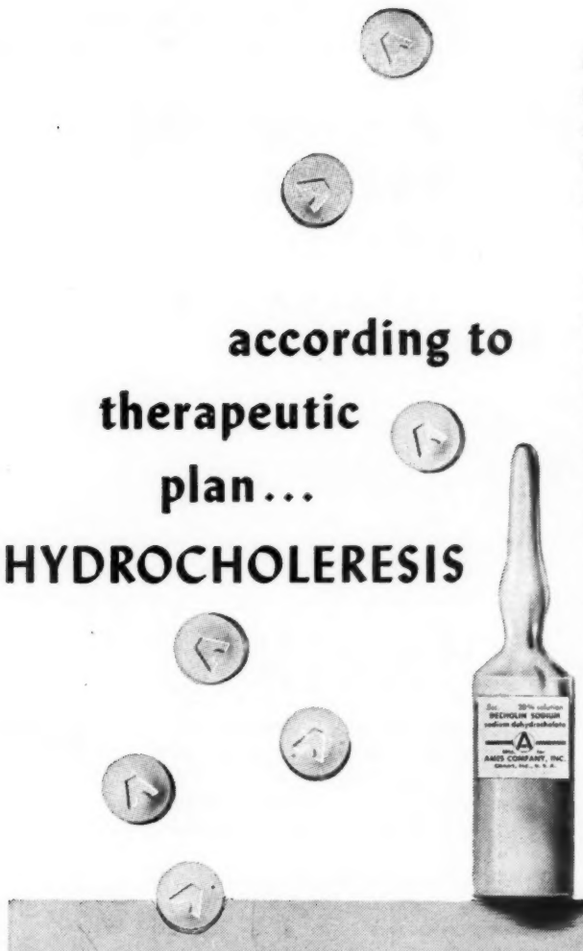

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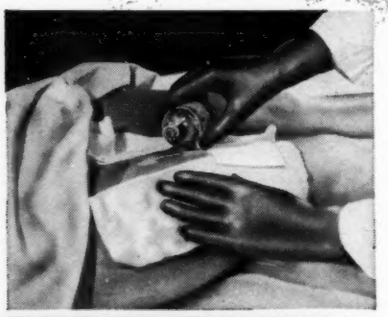

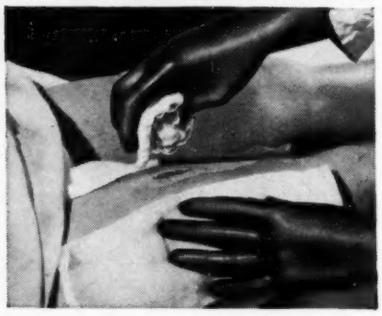

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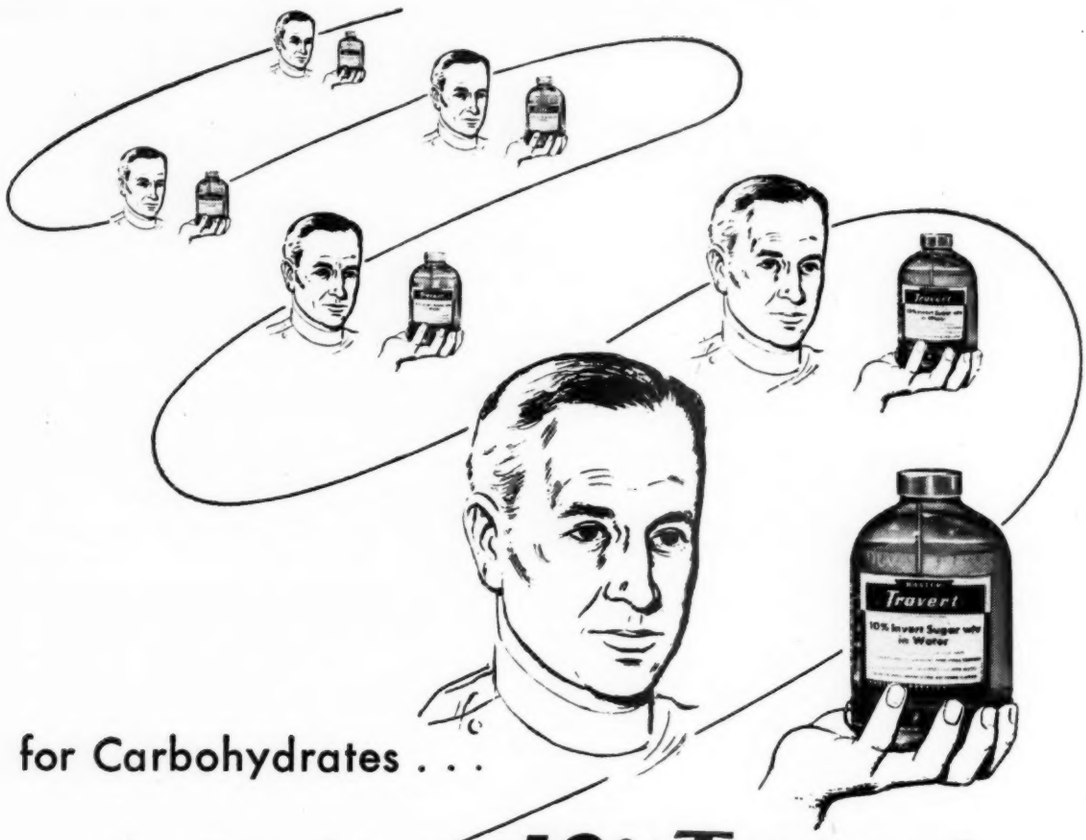

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2. Hopkins, J. G., Hillegas, A. B., Ledin, R. B., Rebell, G. C., and Camp, E., J. Invest. Dermat., 7:237-253, 1946.
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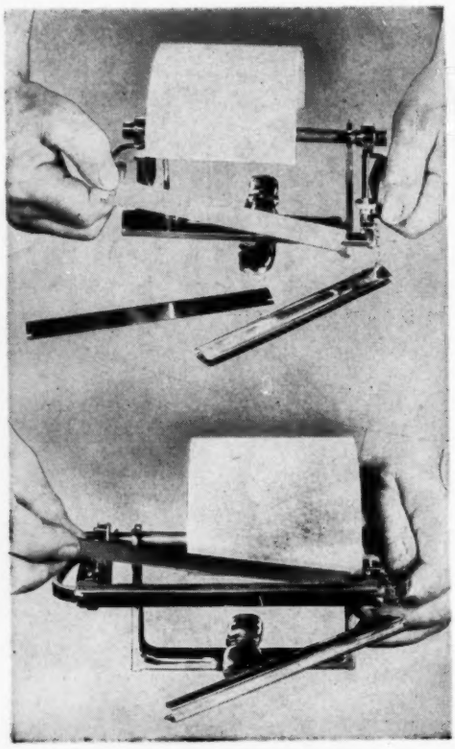

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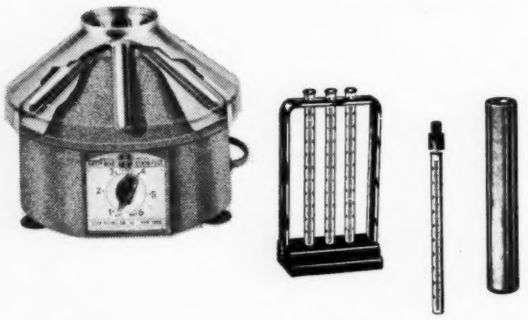

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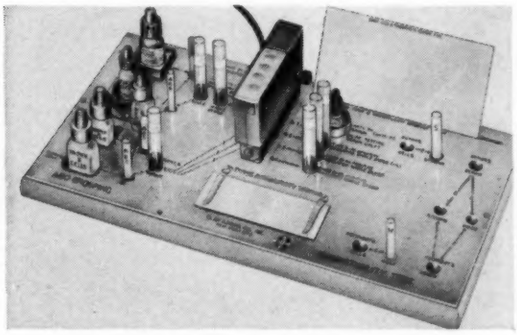

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Plasma "Extenders"

Reports on the experimental use of "plasma extenders" have focused attention on the mechanical aspects of maintaining the circulation. There is a natural tendency to become preoccupied with the purely *physical* considerations involved in restoring the fluid volume and thus to exclude—or to give less regard than is due to—vitally important *biological* considerations. The main objective in the search for plasma "extenders" has been to find colloidal materials that could imitate the natural blood colloids in their ability to increase the osmotic pressure within the blood vessels and so to maintain the circulatory volume. Such materials, it is believed, might serve as temporary expedients in the emergency treatment of shock. But it is recognized that plasma "extenders" cannot be regarded as adequate substitutes for plasma; rather, they would be intended only for emergency use—if the demand for genuine plasma should suddenly exceed the supply—and if the extenders prove to be satisfactory and safe.

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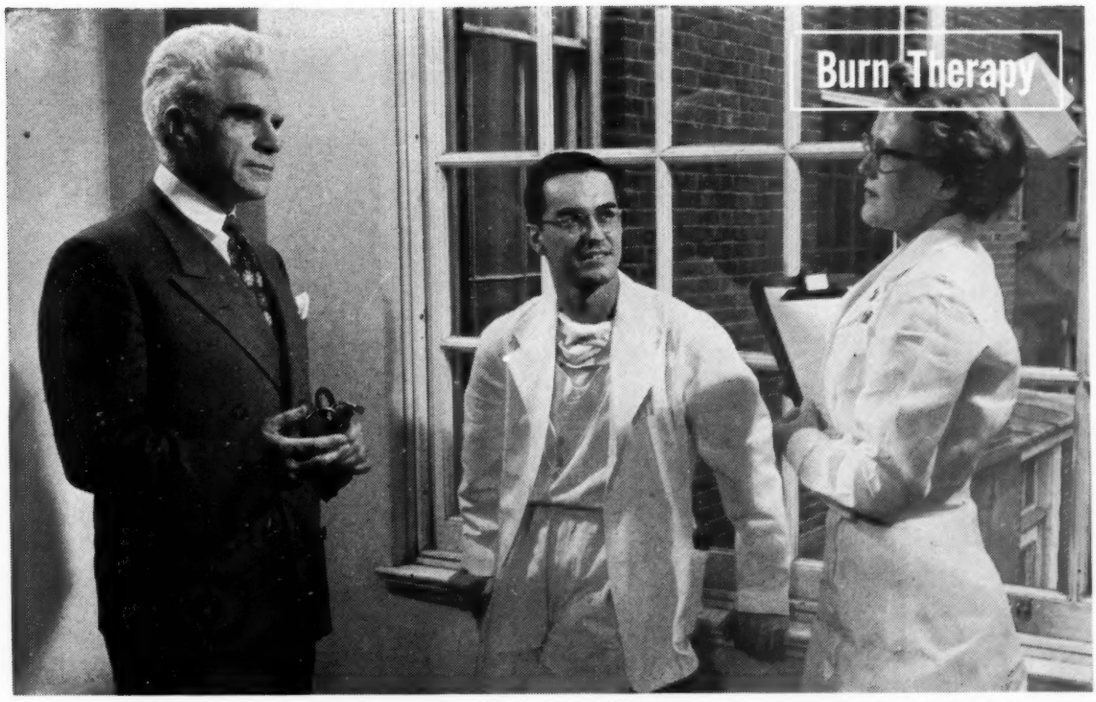

Discussion: Place of blood, plasma and plasma "extenders" in treatment of severely burned patients.

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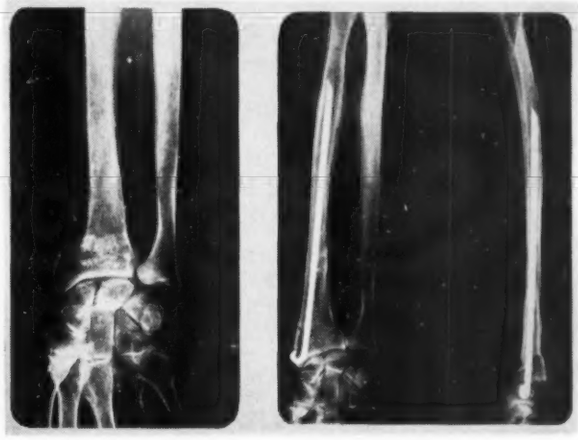

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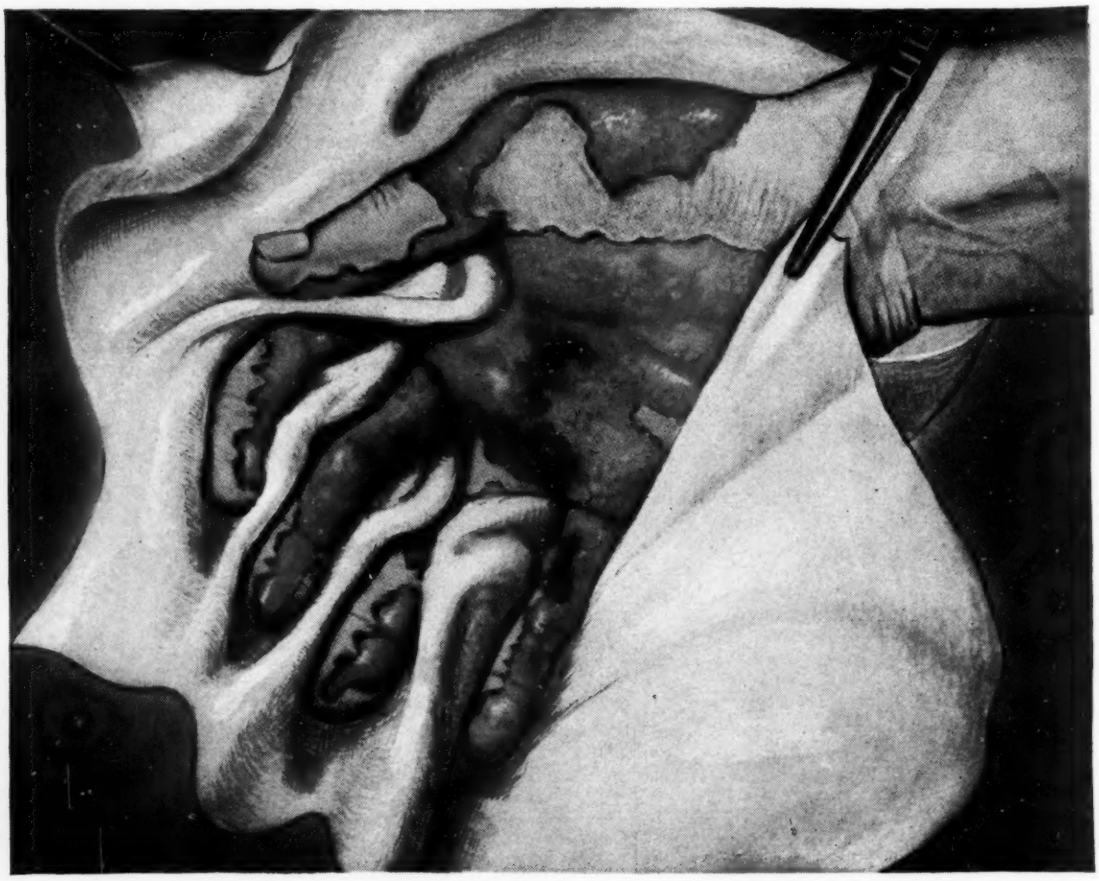

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4. *Promotes healing*—It does not interfere with healing, as do many chemical antiseptics. Where infection is controlled, healing is faster.

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6. *Economical*—Shorter period of disability means a saving in expense and hospital time.

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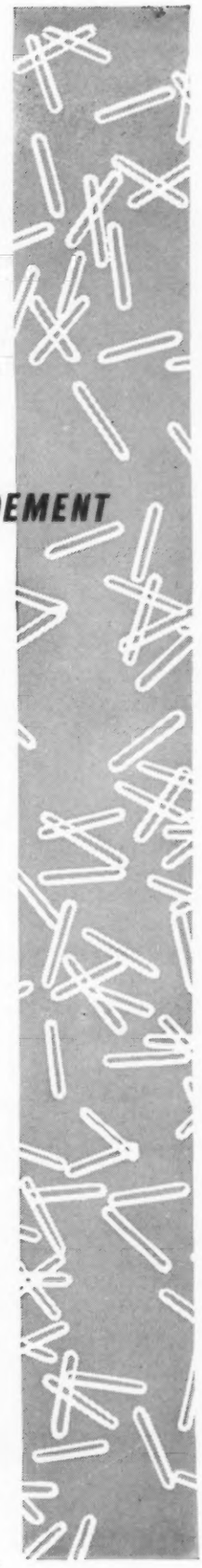

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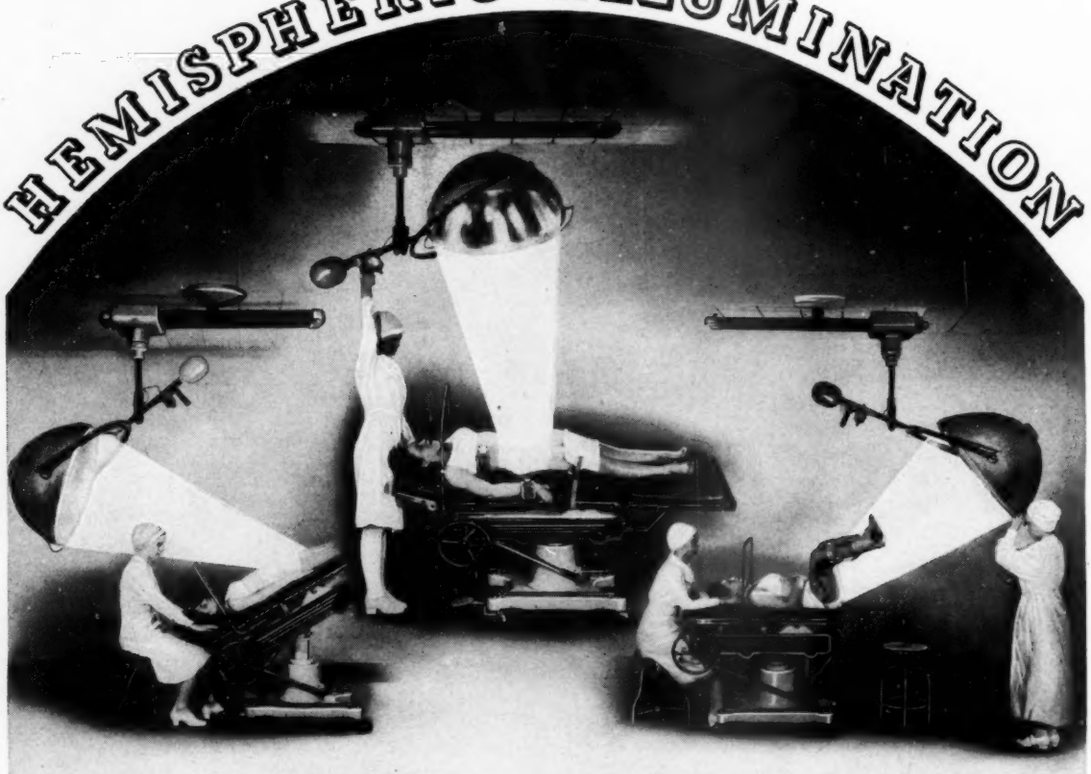

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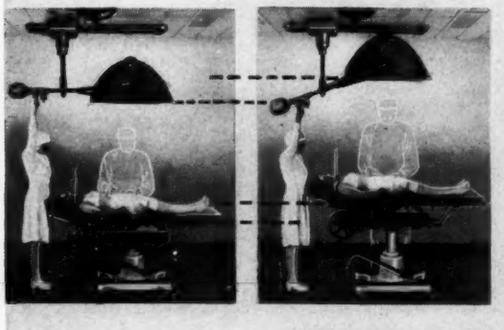

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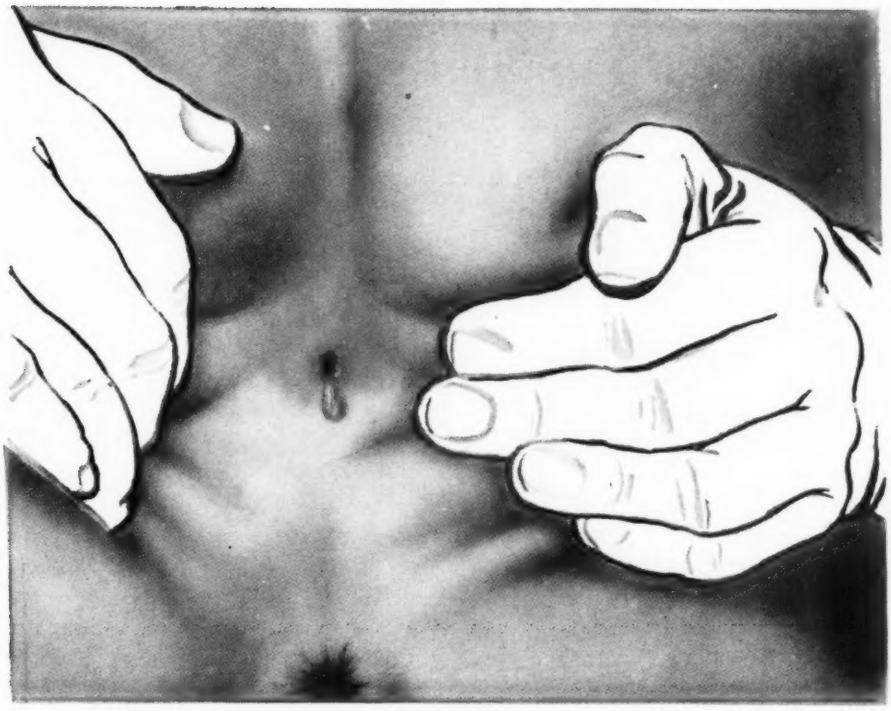

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Wright, L. T., et al.: Antibiotics & Chemotherapy 1:165 (*June*) *1951*

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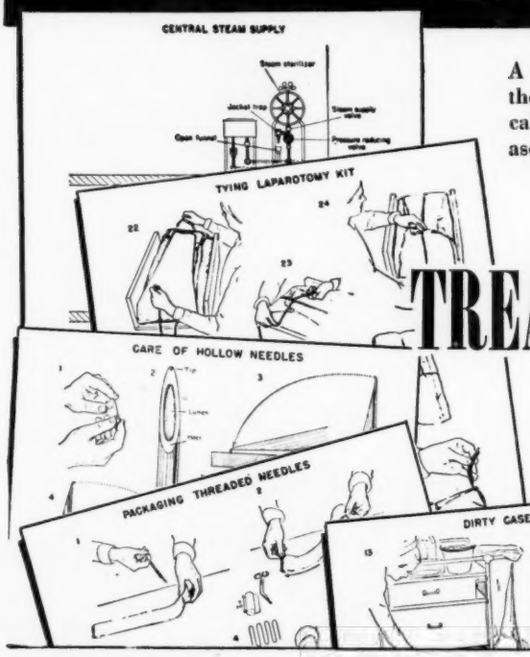

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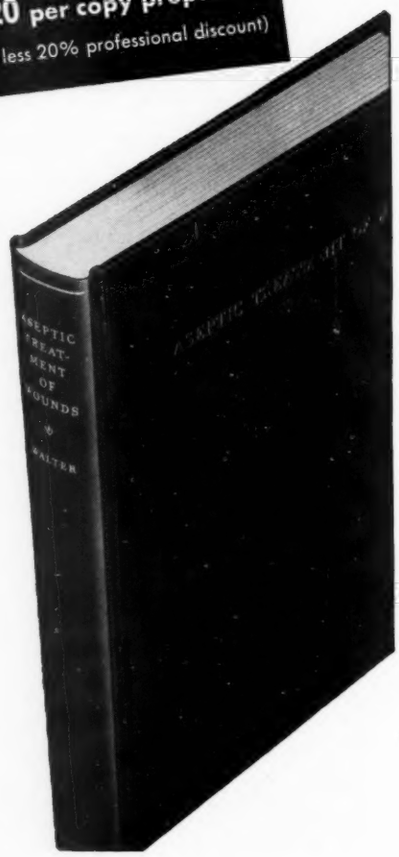

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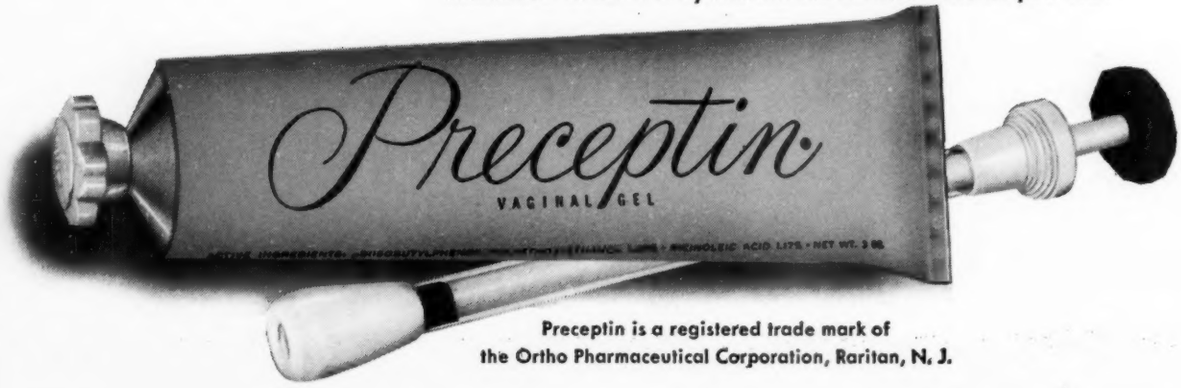

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Outside the Ivory Tower

ALTHOUGH it was the young who a century ago were advised to go West, since 1900 the elders among us have moved westward more readily. There are now about 1,575,000 persons at the age of sixty-five or over in the Pacific Coast and Mountain States, which is ten times the number at the century's turn. For comparison, in other sections of the United States the number of persons in the sixty-five or over age group is about four times what it was in 1900. In the South the number of aged in 1950 was 4.16 times that in 1900 while in the Northeast the ratio was only 3.41, the lowest for any region. The high rate of increase in the West resulted largely from the attraction to that region—particularly California—of elderly widows and retired persons, the statisticians of Metropolitan Life note. After 1940 there also was a large scale movement to the West of young adults and their children.

An extremely rapid increase is noted in the number of older women in the West. In 1900 women were outnumbered by men in the West's population at sixty-five and over, there being only 634 women to every 1,000 men. By 1950 this was reversed and there were 1,078 women for each 1,000 men.

"The ratio of females to males at these ages, nevertheless, is still lowest in the West," the statisticians point out. With all areas of the country facing the problems arising from an aging population, in the West an additional problem is created by the large number of aged migrating there.

DR. Loyal Davis, professor of surgery and chairman of the department at Northwestern University's Medical School, has been selected to give the Earl of Litchfield lecture at Oxford University next October 10th. Dr. Davis will talk on "The Physiological Principles Underlying the Treatment of High Diastolic Hypertension by Thiocyanates and Sympathectomy." Named the first Grunow Professor of Surgery at the University, Dr. Davis is a graduate of Knox College, Galesburg, and of the Northwestern Medical School. He has been a member of the Northwestern faculty since 1925 and chairman of the department of surgery at the University since 1932. He is a regent of the American College of Surgeons and Editor of *Surgery, Gynecology and Obstetrics*. During the war Dr. Davis served as a consultant to the Chief Surgeon of the Army.

DR. Richard H. Young, Dean of Northwestern University's Medical School, announced that the Departments of Chemistry and Experimental Medicine are being combined into the Department of Biochemistry. "Biochemistry in recent years," Dr. Young explained, "has assumed greater and greater importance in the fundamental instruction of medical students, and the basis of all medical research is becoming more dependent on the physical sciences. Research in experimental medicine is almost exclusively biochemical in nature."

IN announcing the appointment of Dr. Victor Lorber of Cleveland, Ohio, as its first Career Investigator, the American Heart Association recently became the first voluntary agency to undertake a program providing for continuing careers of scientific research investigators of proved ability and originality. Dr. Lorber, Associate Professor of Biochemistry at Western Reserve University, will receive a starting annual stipend of $12,000 to conduct research relating to disorders of the heart and blood vessels. It is the intention of the Association to continue this support throughout the productive life of the Investigator.

PERSUADING the 25,000,000 or so adult Americans who are overweight to lose their excess poundage through intelligent dieting under medical supervision has been made a major public health project by the Metropolitan Life Insurance Company. The undertaking has the support and active cooperation of the Public Health Service of the Federal Security Agency and the American Medical Association. The effort is concerned primarily with those persons who whip the dial of their bathroom scales to a point at least 10 per cent higher than that required for their own physical and mental well-being. Their number is estimated at the 25,000,000 figure. Thus, even at the admittedly conservative average of twenty pounds of excess per overweight person, the mass objective would be the loss of some half a billion pounds, which probably makes it the most ambitious weight reduction campaign in all history.

(continued on page 28)

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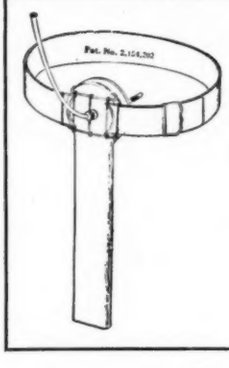

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Outside the Ivory Tower

(*continued from page 26*)

DISASTERS in which the list of dead tallied 100 or more occurred thirteen times in the United States during the 1941 to 1950 decade, each thus greatly exceeding the Kansas flood toll, Metropolitan Life Insurance Company statisticians report. The highest toll was wrought by the Texas City fire and explosion of April, 1947, in which 561 lives were lost. Next high in number of deaths were the 1942 night club fire in Boston, killing 492, and the explosion of two ammunition ships at Port Chicago, California, in 1944, which cost 322 lives.

The other ten disasters in which 100 or more died are:

	No. of Deaths
Hartford, Conn., circus fire, 1944	168
Texas and Oklahoma tornado, 1947	167
Pennsylvania, West Virginia and Maryland tornado, 1944	159
Cleveland, Ohio, gas tank explosion, 1944	130
Oklahoma, Missouri and Arkansas tornado, 1945	119
Atlanta, Ga., hotel fire, 1946	119
Southern and Midwestern States, tornadoes, 1942	111
Centralia, Ill., coal mine explosion, 1947	111
New York Bay, N.Y., destroyer explosion, 1944	100*
Northeastern United States, wind and snow storm, 1950	100*

* Approximately

RESEARCH scientists seeking to build stronger defenses against the heart diseases are being helped by sixty new grants-in-aid in the total amount of $311,912 from the American Heart Association, it was announced by Dr. Louis N. Katz, President. The grants-in-aid approved for various institutions throughout the country bring to a total of ninety-five the number of awards made by the Association during the past year for research studies conducted during the 1951 to 1952 academic year.

ONLY about half as many minor children are orphaned each year by the death of a parent than would be the case if the mortality conditions of fifty years ago continued to prevail, Metropolitan Life Insurance Company statisticians report. In spite of this, in a recent year (1948) about 371,000 children under eighteen became orphaned by the death of either a father or a mother. Of these, 239,000 children lost their fathers and 132,000 their mothers—the wide difference explained by the fact that the average American wife is somewhat younger than her husband and lives longer. Although the chances of death at ages under forty-five are relatively small, according to the statisticians, about 90,000 children lose such comparatively young fathers during the year.

PLANS for the development of the basic sciences buildings as the nuclei of two great State University medical centers in New York City and Syracuse were revealed by Alvin C. Eurich, President of State University of New York. Public announcement followed approval of the plans by the Board of Trustees of State University at their meeting held in New York City. This action of the Trustees marks the beginning of physical expansion necessary to provide for the contemplated increase in enrollment, according to President Eurich. When completed, State University Medical Center at New York City will accommodate 800 medical students in the four classes. This will be the largest medical college in the United States. The State University Center at Syracuse will provide for half this number of medical students, a total enrollment of 400. It is estimated that the Basic Sciences Building (New York City) will cost approximately $10,500,000 without equipment and the total expenditure for the entire Medical Center may be in the vicinity of $40,000,000. Before the state took over it was The Long Island College of Medicine, founded in 1858.

THE latest facts on immunization for travelers going to every section of the world are detailed in a booklet just released by the U. S. Public Health Service. The title of the booklet is "Immunization Information for International Travel." It includes official information on the immunizations required and recommended by each country and the immunizations recommended by the Public Health Service as a precautionary measure for persons traveling abroad. Other items of importance to the traveler include an explanation of the procedure for having inoculations recorded on the International Certificate of Inoculation and Vaccination; a list of Public Health Service facilities where yellow fever inoculations can be obtained and maps showing the yellow fever endemic areas of the world. The booklet may be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C. for $.20 a copy. A 25 per cent discount is allowed on orders of 100 copies or more delivered to the same address.

(*continued on page 30*)

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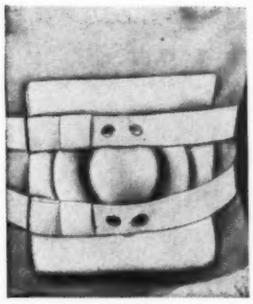

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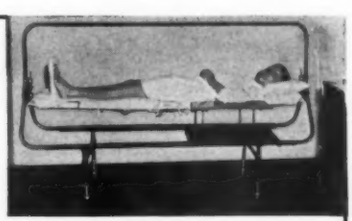

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(*continued from page 28*)

SOME very worth while new books have crossed our desk. We gladly recommend them to whoever might wish a solid work on a particular topic.

The W. B. Saunders Co. has recently published a new work by Meredith Campbell, M.D. Its title is "Clinical Pediatric Urology." There is a section on Nephritis and Allied Diseases in Infancy and Childhood by Elvira Goettsch, M.D. and John D. Lyttle, M.D. The book consists of 1,113 pages and has 543 figures. At the conclusion of each chapter is an ample bibliography. The index is most satisfactory. All in all it is excellent.

The Williams and Wilkins Co. has published the third edition of J. C. Boileau Grant's "An Atlas of Anatomy." It covers by regions, upper limb, abdomen, peritoneum, pelvis, lower limb, vertebrae, vertebral column, thorax, head and neck, cranial nerves and dermatomes. This work was first published in 1943. In this edition more than seventy illustrations are new and twenty-eight of the old illustrations have either been improved or replaced. In all there are over 650 illustrations and many are in color. There is an index; the references are to figure numbers. This is a beautiful bit of publishing and of high grade throughout. The price is $12.

J. B. Lippincott Co. is responsible for publishing "Anatomy in Surgery" by Philip Thorek, M.D. A most complete presentation of the subject, it is 970 pages long. It contains 720 illustrations of which 211 are in color. The illustrations were drawn by Carl T. Linden, Instructor in Medical Illustration, University of Illinois College of Medicine. The author lists twenty basic references upon which he has drawn. The index covers fifty-three pages. This book deserves a large sale. The price is $22.

Grune & Stratton of New York have published "The Kidney—Medical and Surgical Diseases," by Arthur C. Allen, M.D. Dr. Allen is Pathologist, The James Ewing Hospital; Assistant Attending Pathologist, Memorial Cancer Center, New York City; Attending Consultant in Pathology, Veterans Administration Hospital, Bronx, New York. The book is 583 pages long and has 1,115 illustrations. Generous references are at the chapter endings. The index is most complete. This is a valuable and much needed work. The price is $15.

A newly published book, one that will appeal to neurosurgeons and neurologists, general surgeons and those who build medical libraries, is "A History of Neurological Surgery." There were twelve contributors; on the Editorial Committee were Robert E. Green, Herbert C. Johnson and W. Eugene Stern and it was edited by A. Earl Walker, M.D., Professor of Neurological Surgery, The Johns Hopkins University. The Williams & Wilkins Co. is the publisher. The book is 583 pages long, illustrated; the bibliography covers 102 pages and lists 2,371 references. Also, there is an index. It is very instructive and is delightful reading.

Also from the publishing house of The Williams & Wilkins Co. comes a new work, "Endoscopy—As Related To Diseases of the Bronchus, Esophagus, Stomach and Peritoneal Cavity," by Edward B. Benedict, M.D. It is 373 pages in length, is illustrated, has an author index, references at chapter endings and a subject index. Anyone in need of a work on this subject is most seriously urged to consider this authoritative work. The price is $10.

"Treatise on Surgical Infections" by Frank Lamont Meleney, M.D., is put out by Oxford University Press, New York, 1951. The author says this work has been twenty years in the making. Dr. Hans Zinsser in 1940 read the first draft of the manuscript and wrote a foreword (this was shortly before his death). The book is 713 pages long. Ample references are at chapter endings. The illustrations are above standard. There is an index. We are in a new era of the treatment of surgical infections and this new work could well be in every surgeon's library.

From the C. V. Mosby Co. comes "The Management of Fractures, Dislocations and Sprains" by John Albert Key, M.D. and H. Earle Conwell, M.D. It is a fifth edition. Anyone doing general surgery and especially orthopedic surgeons need no introduction to this quality tome. It is a large volume of 1,232 pages, 1,195 illustrations and contains an index. It is well worth the price of $16.

HOSPITALS operated by the Public Health Service under the name "U. S. Marine Hospitals" were redesignated as United States Public Health Service Hospitals (July 1, 1951). This will provide a uniform designation for the twenty-one hospitals now operated by the Service and simplify administrative procedures in their administration.

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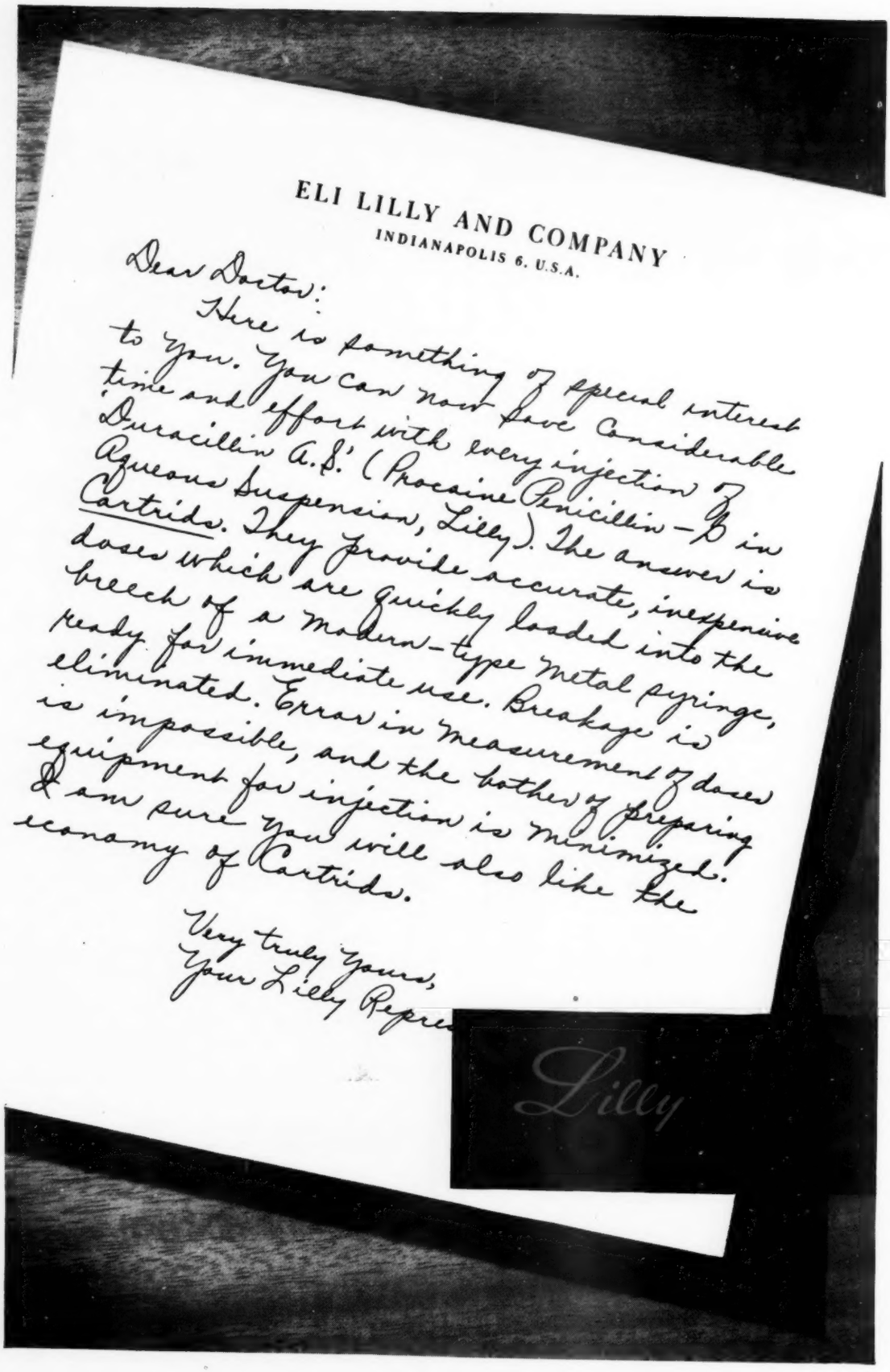

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VOL. LXXXII OCTOBER, 1951 NUMBER FOUR

Editorial

PROCAINE INJECTION THERAPY OF PAINFUL CONDITIONS

SELECTION OF PATIENTS

SINCE the publications of Leriche,[1] Lewis,[2] Kellgren,[3] Steinbrocker,[4] Livingston,[5] Travell,[6] Gorrell[7] and others have appeared, the procaine injection treatment of painful musculoskeletal conditions has become widely used. The technic, especially as compared with intravenous procaine therapy, is safe, rapid and comparatively simple.

Sufficient stress has not been placed upon the proper selection of patients. When patients are not selected properly, poor results follow and the technic is blamed rather than the lack of clinical judgment.

After seeing many dramatic results with procaine injections one becomes enthusiastic and tends to hurry through the history and physical examination in order that one may begin the injection.

One should not inject any patient who gives a history of a nervous breakdown, who complains of symptoms from head to toes, who is receiving compensation and enjoying it, who cannot accurately localize the pain, who does not honestly want relief of pain, who gives a clinical impression of having a psychopathic personality or of being constitutionally inferior.

The normal person wants as little to do with physicians as possible. He consults one only when driven by pain, worry or fear. He appreciates a careful history, a complete physical examination and a fundamental laboratory examination. He is happy when told that no or a minor abnormality is found. He does not want an operation or other painful procedure unless he is sure that it is necessary. Such a person can be told that an injection will relieve his pain.

The person who has something to gain by continuance of pain and other symptoms is happy when told of abnormalities. Such a

[1] LERICHE, R. The Surgery of Pain. Baltimore, 1939. Williams & Wilkins Co.

[2] LEWIS, T. Pain. New York, Macmillan Co.

[3] KELLGREN, J. H. Observations on referred pain arising from muscle. *Clin. Sc.*, 3: 175, 1938.

[4] STEINBROCKER, O. Arthritis in Modern Practice. Philadelphia, 1941. W. B. Saunders Co.

[5] LIVINGSTON, W. K. Pain Mechanisms. New York, 1943. Macmillan Co.

[6] TRAVELL, J. Management of pain due to muscle spasm. *New York State J. Med.*, 45: 2085–2097, 1945; Rapid relief of acute stiff neck. *M. Womans' J.*, 4: 89–95, 1949; Basis for multiple uses of local block of somatic trigger areas. *Mississippi Valley M. J.*, 71: 23, 1949; Pain and disability of shoulder and arm. *J. A. M. A.*, 120: 417–422, 1942; Treatment of painful disorders of skeletal muscle. *New York State J. Med.*, 48: 2050–2059, 1948.

[7] GORRELL, R. L. The nupercaine treatment of lumbago. *Tri-State M. J.*, 11: 2223, 1939. Local anesthetics in precordial pain. *Clin. Med.*, 46: 11, 1939. Treatment of skeletal pain with procaine injections. *Am. J. Surg.*, 63: 102–104, 1944. Musculofascial pain, treatment with procaine injection. *J. A. M. A.*, 142: 557–562, 1950.

person should not be injected or operated upon but should have a careful life history taken and possible psychiatric study.

If the patient is looking for sympathy from friends and family, for a vacation, for an excuse to avoid the distasteful, i.e., coitus, for continuance or increase of pension or compensation, he should not be injected. Such patients do not really seek relief and will not admit it, if obtained. They will rather seize upon the injection as another cause of pain.

The stolid type of person may deceive the physician into belief that little or no pain is present. The individual who drives himself on without regard to pain and who does not worry about pain may be suffering from serious painful disease and yet give no outward indication.

Superficial pain in skin, muscle and fascia can often be localized and described fairly accurately. Deep pain cannot be localized well or described, e.g., the burning beneath the sternum of a coronary thrombosis, the painful pressure of a brain tumor or the hungry distress of a peptic ulcer.

Pain cannot be ruled out by a laboratory test or physical examination. Wolff and Wolf's[8] study indicates that all healthy persons with intact, functioning nervous systems have the same capacity for perceiving pain, i.e., their pain threshold is roughly the same.

What the person's reaction is varies with his previous experience with pain, his mental balance with life's situations, his knowledge about and worry concerning the significance of pain and disease, and his desire to keep on with his work.

"Pain perception needs only a simple, primitive nerve connection. Pain reaction is modified by higher centers. What does the sensation mean to that person in the light of past experience?" Unlike the threshold for pain perception, the reaction varies widely for different individuals and even for the same individual under different circumstances.[8]

Itching is induced by stimuli below the intensity needed to cause pain. Tickling may result from even weaker stimuli.

Other sensations may be confused with pain or may be mingled with it.

If pain is present, there will be interference with the patient's mental or physical activities or both. Mild pain may be overlooked during activity which keeps the mind away from the discomfort. This is the reason for pain becoming more noticeable during the night or other period of inactivity.

Pain caused by abnormality of the musculoskeletal system will be intensified by certain motions or positions, will be relieved by rest, activity or heat, according to its type. It will be relieved by such therapies as massage, analgesics, procaine injection, sympathetic nerve block or ethyl chloride spray.

If severe pain is present, the patient will not be able to sleep well. Also, the patient will not object to an injection or other transiently uncomfortable treatment to obtain relief. Severe pain is not relieved by one or two aspirin tablets. Severe pain colors mental processes and causes them to return to the pain.

TYPICAL SYNDROMES

Two errors occur when one attempts to classify patients into groups. First, a known syndrome may be overlooked because it does not fit the usual pattern and may superficially resemble another condition, e.g., gout may be confused with rheumatoid arthritis.[9]

The second error is to force all patients into diagnostic syndromes regardless of minor differences in symptoms and signs. The patient with low back pain may receive different diagnostic workups and therapy if he or she happens to consult the gynecologist, orthopedist, general practitioner, surgeon or urologist.

Low back pain and sciatica are considered almost diagnostic of protruded intervertebral disc by many orthopedic and neurologic surgeons. The orthopedist tends to focus his attention on the x-rays and to believe that bony abnormalities are the cause of pain. The gynecologist tends to incriminate the infected cervix, the pelvic tumor and the retroverted uterus. The urologist looks for renal, ureteral, bladder or urethral disease.

All physicians must learn the importance of the physiologic as opposed to the pathologic lesion, i.e., the temporary changes in muscle and fascia and their blood supply which produce pain but do not cause any alteration in x-rays or laboratory studies. In such cases the history and physical examination are the diagnostic procedures. Successful therapy at this stage prevents the development of physical and

[8] WOLFF, H. G. and WOLF, S. Pain. Springfield, Ill., 1949. Charles C Thomas, Publisher.

[9] HENCH, P. S. Gout. *J. A. M. A*, 116: 453, 1941.

psychic changes. If pain is relieved or covered up by salicylates or other analgesics, both physician and patient are misled into believing that the underlying condition has been cured.

Many syndromes not yet described are presented by patients. Such patients should not be forced into existing classifications. As one studies hundreds of patients with pain, one becomes aware of the trapezius syndrome, the deltoid syndrome, the stiff neck syndrome of Travell[6] and many others.

A number of cases of musculoskeletal pain are apparently due to imbalance of the autonomic nervous system. The injection of nicotinic acid, histamine or tetraethyl ammonium chloride or procaine block of the sympathetic nerve supply to the area dramatically relieves the pain. Even the cocainization of the sphenopalatine ganglion[10] has been claimed to relieve low back pain.

The pain of sinusitis has been shown to be caused by fibrositis of the muscles inserting around the occiput. Fibrositis is now being used as a synonym for any type of connective tissue pain on a rheumatic basis, and especially if nodules can be felt.

Interestingly enough the procaine injection of a sympathetic nerve may result in the patient feeling stronger. This has also been noted by Karnosh[11] from the Cleveland Clinic.

SUMMARY

One must know something about the patient as a person before one can treat any condition satisfactorily and this is especially true of pain. Certain persons do not wish to be relieved of pain.

One must avoid the tendency to force patient's signs and symptoms into preconceived groups or diagnostic pigeonholes.

One must learn if pain is present and its characteristics.

RALPH GORRELL, M.D.

[10] AMSTER, J. L. Treatment of low back pain. *New York State J. Med.*, 100: 2475, 1948.

[11] KARNOSH, L. Sympathetic block. *Cleveland Clin. Bull.*, 24: 110, 1948.

Original Articles

MALIGNANT NEURILEMOMAS OF PERIPHERAL NERVES*

JOHN O. VIETA, M.D. AND GEORGE T. PACK, M.D.
New York, New York

THE subject of neoplasms of peripheral nerves particularly those of a malignant character has been dealt with considerably in earlier medical literature. Certain features, however, continue to remain obscure. In the past two decades few articles dealing with this subject have appeared. Most recent reports concerning malignant tumors of peripheral nerves have dealt with small numbers of cases. The purpose of this article is to review the experience of the authors in dealing with a number of these lesions in the hope that their experiences may be of value to others who are called upon to deal with similar problems. The present material is based on a study of thirty-one cases of malignant tumors of the peripheral nerves seen at the Memorial Hospital. As these neoplasms can occur in every region of the body, their diagnosis and treatment present a problem to each specialty in surgery.

Terminology. Such tumors are variously reported as neurogenic or neurogenous sarcoma[11,12] and by some as fibrosarcoma of nerves. They are the type that Stout[40–46] has designated malignant schwannomas.

The words neurosarcoma and neurogenic sarcoma[48] have only one advantage in their continued use, and that is, of being well established terms. The authors and others believe that tumors designated as neurosarcoma are derived from Schwann cells which are derivatives of the neural crest and, therefore, ectodermal in origin. It is believed[43,44] that malignant tumors of peripheral nerves derived from mesodermal elements are either very rare or non-existent as far as can be concluded from reports in the recent literature or from a study of this material.

Therefore, due to a confusion in terminology as applied to tumors originating in peripheral nerves it is believed that a simple classification which would denote the origin of these tumors and their behavior characteristics would tend to clarify a varying nomenclature if adopted. For instance the terminology applied to one benign nerve sheath tumor proved to arise definitely from the Schwann cells is variously designated as a peripheral glioma,[32] schwannoma,[24] perineural fibroblastoma[29] and neurinoma or neurilemoma.[40] These terms all apply to one specific tumor arising from the cells forming the sheath of the nerve or neurilemma. Similarly, although the term neurofibroma is so much a basic part of the terminology for certain characteristic nerve tumors, it, too, is a tumor composed for the most part of Schwann cells with the mesodermal elements making up its blood vessels and some of its supportive structure.[44] Whether a neurofibroma is a single small subcutaneous tumor forming on the end of a peripheral nerve, encapsulated neurilemoma, tortuous conglomeration of such tumors as occurs in elephantiasis neuromatosa causing a marked deformity of any part of the body or a solitary plexiform neuroma producing a tortuous enlarged nerve trunk, the basic pathologic disorder in all such variants is a non-orderly overgrowth of Schwann cells and connective tissue with the basic element arising in and from the Schwann cells.

With the following terminology it is the authors' opinion that there would be more clarity in reviewing the literature pertaining to peripheral nerve tumors if the basic fact that these tumors arise from the Schwann cells is kept in mind. The classification† we propose

† This classification has been suggested and incorporates the current views on this subject by members of the Department of Pathology, Memorial Hospital, New York, N. Y.

* From the Memorial Cancer Center, New York, N. Y.

and synonymous terms as commonly noted in the literature follow: (1) benign encapsulated neurilemoma (neurinoma, schwannoma, perineural fibroblastoma, peripheral glioma, neurilemoma; (2) benign plexiform neurilemoma (neurofibroma, plexiform neuroma, plexiform neurofibroma, elephantiasis neuromatosa, elephantiasis neuromatodes; (3) malignant neurilemoma (malignant schwannoma, malignant neurofibroma, neurosarcoma, neurogenic sarcoma, neurogenous sarcoma, fibrosarcoma of peripheral nerves).

Malignant neurilemoma as a distinct entity apart from the usual fibrosarcomas has been recognized for a long time. Many authors[12,14,16,19,23,37,45,50] have made notable contributions to the subject. Thompson[47] in his review of mediastinal tumors and cysts has summarized the pertinent literature pertaining to the manifestations of the neurogenous, malignant and benign tumors found within the chest. However when one is confronted with a patient suffering from a malignant tumor of peripheral nerves and who has been treated by inadequate means over a number of years, it is apparent that many surgeons today still do not recognize the seriousness of the problem with which they have been dealing.

HISTOGENESIS

As a background for this subject one must consider the fundamental anatomy and histopathology involved to consider adequately the relationship of the malignant nerve tumors to the benign encapsulated neurilemoma and the benign plexiform neurilemoma.

Each peripheral nerve trunk is made up of a number of units.[12] The unit consists of a myelinated or non-myelinated neuraxon around which is the sheath of Schwann, a derivative of the neuroectodermal cells of the neural crest as demonstrated by Harrison.[18] According to Nageotte[30] when myelin is present between the sheath and the axon, the myelin probably comes from the axonal component. The histologic studies of Masson[24] and Nageotte and the tissue culture studies by Ingebrigsten,[20] Gay,[15] and Murray and Stout[27,28] would seem to demonstrate that the neuroectodermal Schwann cells can form reticulin fibers *in vitro*. Because of the similarity of reticulin as produced by the Schwann cells and the fibrils produced by fibroblasts difficulty in separating malignant neurilemomas from ordinary fibrosarcomas by histologic methods alone is apparent. In addition to the neuroectodermal derivatives and fibrous tissue, blood vessels, lymphatics and fat cells are found in the nerve trunks.

Stone[38] has demonstrated that in frogs the neural crest cell is multipotential and can produce tissue usually thought to arise only from the mesoderm. The role of metaplasia is verified by many instances. Masson[25] has found striated muscle cells in benign plexiform neurilemoma; Wilson[51] has noted bone formation; Groth[17] noted fat and cartilage in a neurofibroma excised from a patient with von Recklinghausen's neurofibromatosis and Stout[40–46] has also observed cartilage and osteoid tissue in a recurring malignant nerve tumor of the brachial plexus. These observations only further illustrate that the neuroectoderm is multipotential and can give rise to various types of tissue usually considered mesodermal in origin. Ganglion cells have also been seen in neurofibroma. Epithelial-lined cysts were described by Stewart[37] as occurring in a peripheral nerve. Glandular elements producing mucus were noted by Foraker[13] in a malignant neurilemoma. These epithelial elements are probably ependymal in origin. Furthermore, the ability of the Schwann cells to produce reticulin and connective tissue elements accounts for the fibrous tissue contained in the common benign encapsulated and plexiform neurilemomas. Thus the components, mesodermal and neuroectodermal elements of the nerve trunk, are capable of forming some type of tumor of a complex structure. The degree to which each tissue participates cannot always be accurately differentiated because of the very intimate relationship of these elemental parts of the nerve trunk. Most authors[25,37,40–46] now agree that the neuroectodermal Schwann cell is the most active participant in the formation of the benign neurilemoma, neurofibroma and traumatic neuroma. The mesoderm is thought to participate only by providing the blood vessels and supportive connective tissue latticework in these lesions.

The fact that a nerve is found incorporated in a tumor mass is not sufficient proof that the tumor arose from that nerve. Many malignant tumors of a sarcomatous type by their growth may surround and destroy major nerves. However, if the nerve contains or is incorporated in a tumor and the histologic structure is that

of a malignant neurilemoma, this would appear to be conclusive proof of origin in nerve tissue.

RELATIONSHIP OF BENIGN ENCAPSULATED AND PLEXIFORM NEURILEMOMA AND VON RECKLINGHAUSEN'S DISEASE TO MALIGNANT NEURILEMOMA

The voluminous literature dealing with von Recklinghausen's disease or generalized neurofibromatosis need not be reviewed here.[3,21,23,36,49] The protean manifestations of the classic clinical picture, hereditary tendencies, influence of unrelated or intercurrent pathologic processes or normal physiologic changes in the evolution and progressive changeable character of this disease process are well described in articles by numerous authors. The special branches of medicine and surgery must constantly deal with these lesions of complex morphology whose individual variations are unlimited. The papers of Garre,[14] Hosoi,[19] Geschickter[16] and Lewis[23] emphasize the frequency with which malignant neurilemomas (10 to 15 per cent) are encountered in patients with von Recklinghausen's disease; the malignant tumors were observed more frequently in the deeper nerve trunks.

While typical cases of generalized neurofibromatosis in which tumor nodules are widely distributed over the body are not common, the atypical cases or forme fruste types are seen more frequently. In this abortive form in which one or more areas of the body show the typical coffee-like pigmentation and one or several cutaneous or subcutaneous plexiform neurilemomas, these stigmata may be an essential clue in arriving at the diagnosis of a malignant peripheral nerve tumor.

The benign, encapsulated neurilemoma or schwannoma is found frequently in patients (18 per cent) with von Recklinghausen's disease. While its typical histologic structure exhibits two types of tissue, namely, the palisade type A with Verocay bodies[4] and the reticular myxomatous type B with spindle cell component as described by Antoni, the benign encapsulated neurilemoma is found in patients with von Recklinghausen's complex; rarely, however, does it exhibit a malignant change. Stout[40] studied 144 of these tumors. Not one became malignant and only one recurred locally following incomplete removal. On the other hand the neurofibroma or benign plexiform neurilemoma, whether or not associated with frank von Recklinghausen's disease, may undergo malignant transformation although in the authors' opinion not as often as thought by Hosoi.[19] In this group of cases particular examinations were usually made to determine the presence or absence of stigmata of von Recklinghausen's neurofibromatosis. However, in the abortive type of the disease if the stigmata are not specifically looked for, they will be missed. As these patients were cared for by various persons, undoubtedly some of the cases reported in this article had stigmata that were overlooked.

The thirty-one cases studied in this survey do not represent the entire experience with malignant peripheral nerve tumors at Memorial Hospital as no cases previously reported by Stewart and Copeland[37] are included in this communication. Because of the influence of the senior author of that study these tumors have been rigidly selected from a heterogeneous group of soft part sarcomas variously classified as spindle and giant cell sarcomas (the fibrosarcomas reported by other authors.)[2,26,50] Many in this latter group were thought by Ewing[1,10] to be sarcomas of neurogenic origin. Unless the tumors had the criteria herein given for making this diagnosis of malignant neurilemoma, they were excluded from the survey. Neuroblastic tumors of the sympathetic and chromaffin system (sympathagonioma, sympathoblastoma, malignant ganglioneuroma or sympathetic neuroblastoma) and peripheral neuroepithelioma (Cohn–type tumor)[5,22] were purposely excluded from this review.

Age and Sex Distributions. Of the group there were sixteen females and fifteen males; other cases reported usually show a slight preponderance for the male. The average age for the male patients on admission to the hospital was 43.0 and for females, 33.5 years. This is in agreement with others who found that malignant neurilemomas appear to occur in a definitely younger age group in the female. The youngest patient in the group was a female age five and the oldest, a male seventy-one years of age.

CLINICO-PATHOLOGIC GROUPS

The series of tumors should be classed in two clinico-pathologic groups: group 1, malignant neurilemoma with stigmata of classic von Recklinghausen's neurofibromatosis and gross

and microscopic evidence of nerve tissue origin; group II, malignant neurilemoma without stigmata or if stigmata are present, they were not especially noted in the clinical record.

More importantly the tumors all had nerve connections demonstrated anatomically or gross and microscopic examinations demonstrated origin from peripheral nerve tissue.

Group I totals eleven patients; seven of these were females and four were males. The patients in group I had an average age of thirty-two years with females averaging twenty-eight years and males thirty-nine years. In group II there were twenty patients, nine females and eleven males. The average age was forty-two years, females averaging thirty-seven years and the males, forty-four years. Certain observations are noteworthy. In the females of group I malignant neurilemoma developed earlier (average twenty-eight years) than in males (average thirty-nine years). In the second clinical group the age distribution of the females (average thirty-seven years) and males (average forty-four years) shows a slight significant difference. With the evidence at hand it appears that females with von Recklinghausen's disease more frequently develop malignant nerve tumors and this neoplasm occurs at an earlier age. In the female with generalized neurofibromatosis the periods of puberty, pregnancy and the menopause are definitely known to affect the clinical course of the disease. What relationship these physiologic processes in the female had to the primary occurrence of malignant neurilemoma could not be deduced from any evidence found in these clinical records. In one patient, however, recurrence developed during pregnancy and the tumor grew with explosive rapidity. (Fig. 10.) We repeat Hosoi's often quoted statement, "In some cases the mere extirpation of a malignant tumor, or even a benign one, appears to stimulate another neurofibroma distally located to undergo sarcomatous transformation." Because of this latter statement many have believed that interference with benign peripheral tumors is unwarranted as extirpation or any type of treatment may be the stimulus to formation of a malignant tumor. In a large experience with the treatment of many benign nerve tumors the authors cannot recall any case in which excision of a benign tumor was followed with recurrence of a malignant tumor. In those instances in which this appears to have taken place review of the sections of the pathologic material at the first excision usually will reveal on closer study portions of the tumor which had already undergone early malignant change.

SYMPTOMS AND CLINICAL PICTURE

There are no characteristic symptoms of this neoplasm and no symptoms that occur can be considered diagnostic. The chief reason the patient usually comes for advice is the presence of a tumor mass. In those patients with von Recklinghausen's disease the recent, more rapid growth of a small mass which may have been present without symptoms for a long time causes the patient to seek aid because of the fear that the growth has become cancerous or increase in the size of the mass has begun to cause pain or inconvenience.

The following symptoms occurring in these thirty-one patients sum up the clinical manifestations which first led the patient to seek medical aid: growth of a painless mass, twenty-three patients; growth of a mass with simultaneous pain, three patients; pain present before any mass was noted, two patients; paresthesias and hyposthesia before tumor mass was noted, one patient; cough and dyspnea, two patients; recurrent or residual tumor on first examination at the Memorial Hospital, fourteen patients; gross objective neurologic signs present when examined, six patients.

Despite the fact that all these tumors arise in peripheral nerves, only seven of the patients exhibited neurologic symptoms other than pain when examined. This accentuates the observation that the nerve from which the tumors arise may appear to be inextricably bound within the tumor mass; yet there usually remain nerve fibers able to carry on some degree of function. Therefore, when neurologic signs are present, they offer a clue that the tumor may arise in a peripheral nerve. The lack of neurologic signs, however, does not signify that the tumor does not arise in peripheral nerves. The diagnosis must then be made with the aid of findings at surgery or dissection of the excised specimen plus the study of the histologic architecture.

Symptoms may be present for a considerable time before they are striking enough to cause anxiety. In analyzing these thirty-one case reports fairly accurate data are present in

twenty-six. If the data are analyzed for the duration of symptoms before an accurate histologic diagnosis of malignant tumor is made, the mean duration of symptoms is twenty-two months. In the other five patients the duration of symptoms ranged from seven

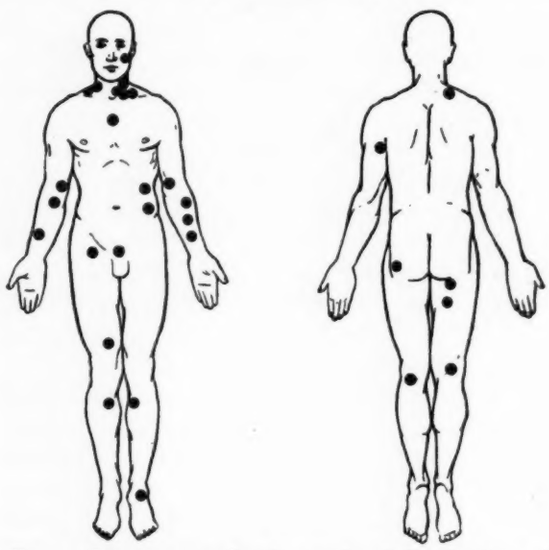


FIG. 1. Scattergram showing regional distribution of malignant neurilemoma.

to thirty-one years. In all of these five patients a tumor was present or had been previously removed from the same site at which a later excised specimen showed a malignant neurilemoma. The mean duration of disease before accurate diagnosis in this group of five patients was 16.5 years. In a disease process extending over such a range of time it is impossible to deduce when malignant transformation occurred in benign plexiform neurilemoma or whether the disease was malignant from its inception. If the total group of thirty-one patients is taken as a whole, the mean duration of symptoms is forty-nine months before histologic diagnosis of a malignant tumor was made.

In fourteen of the thirty-one cases reliable data are available to determine the total duration of disease from onset of first symtoms to death due to tumor. The mean total duration was found to be seventy-six months. The periods vary from eight months to twenty-one years. Of the thirty-one cases seven were clinically cured for more than five years after the last treatment.

Thus from studying the clinically cured and fatal cases the conclusion must be drawn that malignant neurilemoma is for the most part one of the more slowly growing cancers. However, these tumors, like tumors in general, differ markedly in their clinical course. Although most of these tumors may remain localized for a long period, death eventually occurs from massive local recurrence with ulceration, infection, pain or hemorrhage with resultant cachexia or from metastases to the lungs.

In fourteen of the cases follow-up from inception to death revealed that seven patients died of metastases to the lungs, two of these also having a local recurrence. Five patients had locally inoperable disease when first seen; two patients of this group, with the primary disease in the brachial plexus, died of paraplegia due to local extension of the disease to the spinal cord. Two patients, both with tumors originating in the cervical nerves, died of a local recurrence. One was clinically free of disease and died of a coronary thrombosis after more than five years; another patient, without evidence of disease for twenty months, died of apoplexy.

Stout[40–46] in his analysis of 107 cases of fibrosarcoma noted a local recurrence rate of 60 per cent, with only 8 per cent of the patients followed up having shown metastases. In our group of malignant neurilemomas, in fifteen of whom the outcome is already shown, seven (46 per cent) died of lung metastases. Furthermore although less frequently seen than fibrosarcomas, these malignant nerve tumors more frequently result in death, recur locally and as a group are more malignant than the fibrosarcomas with which they are most frequently confused by many authors.

DISTRIBUTION OF MALIGNANT NEURILEMOMA

In Figure 1 the distribution of the thirty-one cases of malignant neurilemoma is shown graphically. The sites of predilection for these tumors are apparently in the extremities, with the upper extremity being more frequently involved. It is readily seen that the tumors may be found anywhere. So far we have not encountered one in the abdominal cavity proper. Ransom and Kay[35] have reported several abdominal neoplasms of neurogenic origin. Likewise Adrian, Kohtz and Hartmann have noted cases of malignant nerve tumors of the intestinal tract. Those found retroperitoneally

about the lumbosacral plexuses in the authors' experience have extended into this area from tumors originally situated in the buttock or femoral triangle.

By tabulation these tumors were found in the following gross anatomic locations: arm three, forearm five, thigh and buttock five, popliteal space two, back five, brachial plexus three, leg two, suprascapular fossa one, mediastinum one, abdominal wall two, foot one and perineum one.

In reviewing the surgical findings and gross anatomic dissections of these tumors the major nerve trunks demonstrated in frequency of involvement were in seventeen cases as follows: median five, sciatic two, ulnar two, radial one, brachial plexus three, femoral one and peroneal nerve three. Malignant neurilemoma originating in plexiform neurilemoma or elephantiasis neuromatosa was noted in twelve cases. In two cases we were not able to demonstrate grossly the nerve from which the tumor originated. In one of these the patient had the neurofibromas of von Recklinghausen; in the other the microscopic architecture conforms to the usual type.

PATHOLOGIC ANATOMY

As previously written the majority of these tumors develop along a recognized peripheral nerve. In the solitary form of malignant neurilemoma the growth may remain encapsulated or confined within the nerve sheath expanding it or forming a round or fusiform mass whose shape is thus determined by the denseness of the surrounding tissue in which the nerve tumor is expanding. These solitary tumors may reach large proportions without showing any noticeable gross infiltration of surrounding tissues. It is evident that these tumors are grossly encapsulated but the capsule is in reality a pseudocapsule. Points at which this "capsule" adheres to muscle, fascia, bone or vessels can usually be shown histologically to contain viable tumor cells. These areas of adherence are of microscopic infiltration and are the foci which serve as a nidus for local recurrence if the tumor is "shelled out" of its capsule. These solitary lesions tend to grow along the nerve trunk more than they do into the tumor bed. The nodules may, however, represent a multicentricity of origin for some malignant neurilemomas as outlined by Geschickter[16] and Stewart.[37] It can be demonstrated histologically that extension may be by continuity of growth by way of the intraneural, perineural and perivascular lymph spaces. It is believed that growth along such routes may be one reason for the frequency of recurrences. Stewart and Copeland stated that the malignant nodules occurring in the nerve proximally or distally from the main mass originally or as "recurrences" represented a new tumor arising in a condemned segment of the nerve. Thus multicentricity of origin, growth by continuity along the nerve, tumor embolization along lymphatics or seeding of the operative region with neoplastic cells may all be factors concerned in local persistence or recurrence of the disease. Growth by continuity along the nerve and embolization along lymphatics account for some of the local recurrences in locally excised or amputated specimens in that the parent nerve is not sacrificed sufficiently proximal or distal to the local growth to remove the neoplastic process extending microscopically within the nerve trunk. Although tumor cells are occasionally seen in the lymphatics coursing with the nerve, the authors have not demonstrated regional lymph node metastases from the tumors although others on occasion have observed lymph node involvement both early and late in the course of the disease. Encapsulated satellite nodules distant from the main tumor may be seen as bulbous enlargements along the course of the main nerve involved or may occur along its proximal or peripheral branches.

The gross extent of the tumor can often be delimited by observing the thickening and edematous appearance of the perineural tissue. It is perplexing to note how a nerve may be seemingly grossly destroyed by the tumor; a normal-appearing nerve is seen entering the tumor and distally reappearing in normal gross configuration. It is impossible to dissect the nerve through the tumor mass yet almost normal function of that nerve may be preserved as the axis cylinders are displaced but are still intact. This feature is equally evident in those malignant neurilemomas originating in plexiform neurilemomas. In this latter group the tumor grossly appears to be of an infiltrative nature, but this is due to the fact that the plexiform variants, themselves, appear infiltrative because of their tendency toward diffuse distribution along natural tissue planes.

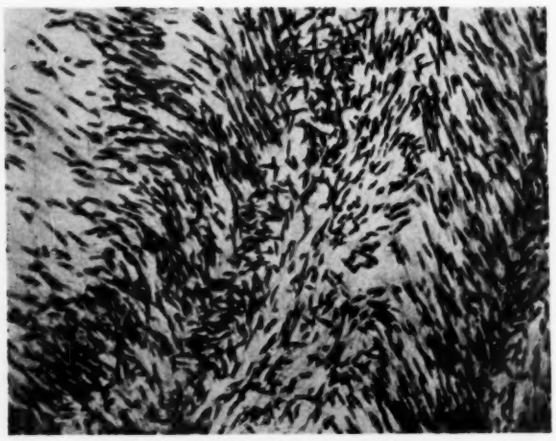


FIG. 2. Malignant neurilemoma, grade 1. Fine palisaded spindle cell structure in a tumor of the right thigh; died in twenty-four months from pulmonary metastases.

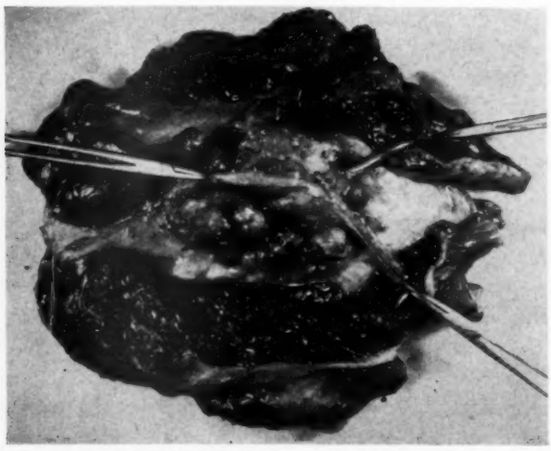


FIG. 3. Malignant neurilemoma of right radial nerve; local excision; lived twenty-two months without recurrence.

In the malignant neurilemomas originating in plexiform neurilemomas, interspersed with interlacing strands of firm white tissue showing tortuous bulbous enlargements of neuromatous peripheral nerves, there are lobulated, grape-like masses of encapsulated semi-gelatinous tissue in addition to nodules of firmer white granular tissue.

In those malignant neurilemomas originating in benign encapsulated neurilemoma the tumors are said to be grossly encapsulated and on cut section are usually firm in consistency with some areas being soft and jelly-like showing small cystic areas. These malignant neurilemomas in no way differ grossly from benign tumors and the diagnosis rests on histologic grounds and clinical behavior. The authors have reviewed the neurilemomas observed in this hospital and not one malignant neurilemoma originating in an encapsulated neurilemoma was found. Several showed changes in histology from the usual architecture which were at first thought to be in a transitional stage indicative of early malignant change, but each of the patients who had this type of tumor has remained free from local recurrence of the disease or metastasis despite only local excisions. This is not the usual history with malignant neurilemomas. The authors believe that a malignant neurilemoma originating from a benign encapsulated neurilemoma must be indeed a very rare tumor.

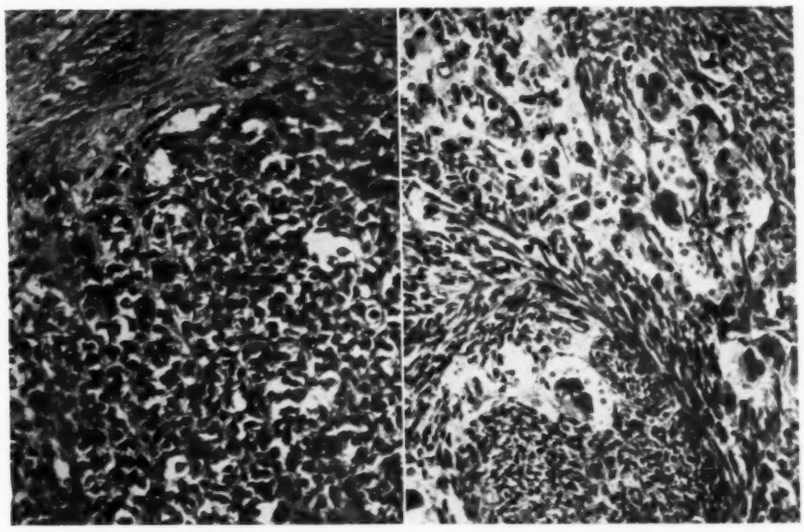
These malignant tumors may by reason of contiguity produce pressure necrosis or osteitis of bone and occasionally invade and destroy the cortex of a neighboring bone. The bone lesions of von Recklinghausen's neurofibromatosis can be found often by roentgenography. The authors have never observed or seen reported an authenticated malignant transformation of neurofibroma or neurilemoma in bone.[8]

HISTOPATHOLOGY

It is not the purpose of this communication to undertake a thesis on the micropathology of malignant nerve tumors. However, salient points in pathologic diagnosis are to be stressed to differentiate the tumors from other types of soft part sarcomas. We believe that for the purpose of this communication the accompanying photomicrographs demonstrating various examples of these tumors adequately describe the micropathology without resorting to detailed word pictures that would confuse rather than clarify a varying histopathologic pattern.

In those tumors we have classified as grade 1 by the Broders' method the primary feature is usually that of a malignant neurilemoma originating in a plexiform neurilemoma. Large hyperchromatic nuclei interspersed with tissue showing a more benign appearance are often the earliest manifestation of the malignant transformation. The reticular structure seen in these early malignant tumors is similar to that seen in the neurilemoma showing the histologic structure usually denoted as the Antoni type B reticulated myxomatous form.

Figure 2 (Case 15) represents a malignant neurilemoma grade 1. Although the malignant tumors with this type of architecture seldom



4 5

FIG. 4. Anaplastic malignant neurilemoma, grade III.
FIG. 5. Malignant neurilemoma, grade III, illustrating anastomosing spindle cell strands intermixed with pleomorphic giant cell foci; tumor of median nerve; died of metastases nine months after amputation.

metastasize, this tumor arising in the femoral nerve caused death by metastases.

In some tumors all gradations of structure may be manifested running the gamut from early malignant change in benign plexiform neurilemoma with all intervening stages up to a highly pleomorphic malignant neurilemoma with giant cells. The tumor when first noted and excised may have a histologic pattern denoting a low grade malignant form and with recurrence the tissue often shows higher degrees of anaplasia. The converse has also been noted on occasion.

Figures 3 and 4 illustrate a radial nerve tumor with varied structure ranging from the usual spindle cell foci to a quite solid anaplastic grade III neoplasm. (Case 19.) Figure 5 (Case 9) shows a median nerve tumor with anastomosing spindle cell strands intermixed with pleomorphic giant cell areas.

Figure 6 (Case 28) is an example of an anaplastic malignant neurilemoma arising in a branch of the common peroneal nerve of a patient with generalized neurofibromatosis. Figure 7 depicts the varying histologic structure. Figure 8 (Case 27) is another example of a malignant neurilemoma of the sciatic nerve in a patient with von Recklinghausen's neurofibromatosis. The histology is illustrated in Figure 9.

FIG. 6. Generalized neurofibromatosis of the von Recklinghausen type. The tumor excised from the left popliteal space is shown in Figure 7.

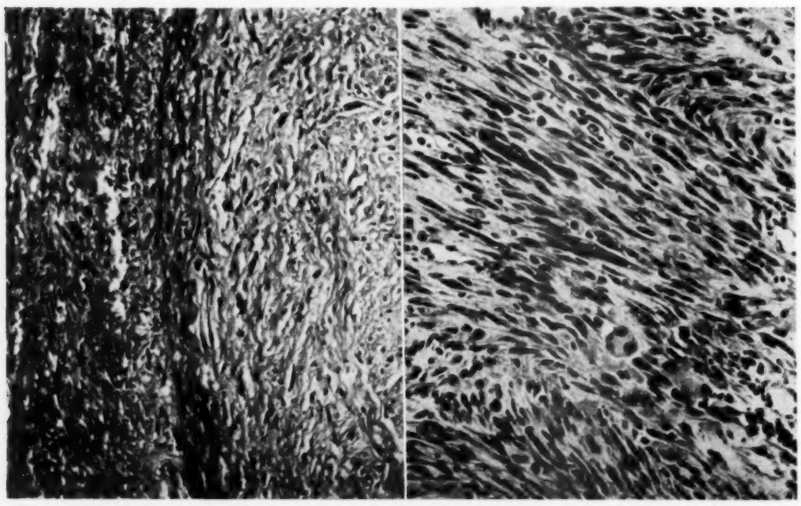


FIG. 7. Malignant neurilemoma, grade III, of common peroneal nerve indicating first early malignant changes in plexiform neurilemoma, and adjacent regions depict pleomorphic spindle cell structure; living for twenty-eight months.

8A

8B

FIG. 8. A, Malignant neurilemoma of the sciatic nerve; B, tumor of sciatic nerve shown in Figure 8A, removed by a palliative hip joint disarticulation.

TREATMENT

It is strikingly apparent from the analysis of this material that the proper type of treatment for malignant neurilemoma is not generally appreciated. Whether inadequate therapy is the result of faulty diagnosis or lack of appreciation of the serious nature of this condition is difficult to confirm. It will be pointed out later that certain surgical principles must be rigidly adhered to in order to better the end results of treatment.

Twenty patients of the series had been previously treated or observed for varying periods before coming to this clinic. Of these patients fourteen had prior surgical treatment. Thirteen of these fourteen had residual or recurrent neoplasm in the operative regions when first seen here thus denoting probable inadequate surgical procedures at the former operative attempts. Of the fourteen patients previously treated by some type of local surgery eight patients had one prior excision, one patient two operations, four patients three attempts and one had four procedures. The primary treatment proved to be adequate and required no further surgery in only one of the fourteen patients. (Case 11.) Even this patient, however, had three operations at another hospital before the neoplasm was controlled.

Of these fourteen patients with primary surgery elsewhere one (Case 16) had three former operations for a plexiform neurilemoma of the neck; the last tissue removed also showed malignant neurilemoma; the patient had an inoperable tumor when admitted. In another patient (Case 29) an inoperable cervical and mediastinal plexiform neurilemoma had been found; an attempted removal here two years later disclosed benign and malignant neurilemoma. Due to the diffuse nature of the disease process in these two patients surgery could not have eradicated the disease. One of the fourteen patients (Case 23) with signs

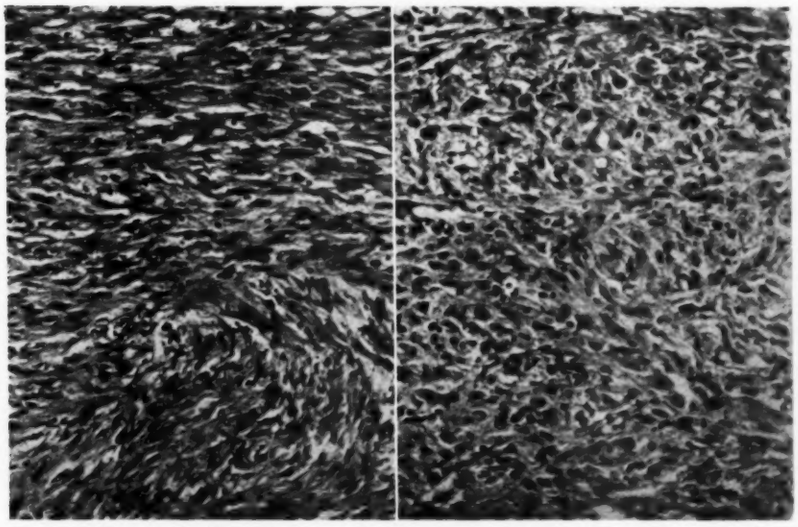


FIG. 9. Mixed spindle and giant cell structure, grade III, from tumor of sciatic nerve; died in four months.

and symptoms of a probable brachial plexus tumor present for about two years was not explored until a large mass became evident which was inoperable when first seen here. Another patient in this group had tissue removed eighteen months before from a small lesion in the right posterior triangle of the neck. (Case 17.) No definitive treatment was given in the interim as the tissue had been diagnosed elsewhere as neurofibroma. The tumor increased markedly in size under observation. The submitted slides revealed a spindle cell sarcoma. The huge operative specimen here showed definite pleomorphic malignant neurilemoma in plexiform neurilemoma. These two latter patients might possibly have been saved by proper early treatment.

In six of the twenty patients previously treated or observed when a probable diagnosis of malignant soft part tumor had been correctly made, the therapy given was exclusively x-ray therapy or radium. In four of the patients x-ray therapy was given before any definite histologic diagnosis was established. Thus in these four it is evident that those who undertook to treat this disease had no understanding of the therapeutic principles involved.

The treatment rendered here to save the twenty previously treated patients plus the eleven without prior definitive treatment can be classified in the following categories. (Table 1.)

The question arises as to what effect the modalities of radiation therapy (x-ray, radium or gold radon seeds) have upon these tumors. We believe that radiation therapy has been given a more than adequate trial in treating this type of neoplasm. From our data considering those patients who had radiation therapy before admission in addition to those treated postoperatively or for palliation here we have noted that of the nineteen treated by some form of radiation therapy only two tumors (Cases 10 and 23) showed appreciable diminution in size. Three patients (Cases 11, 19 and 28) were given postoperative x-ray therapy with the concept of prevention of local recurrence. None of this group has had local recurrence during the period of observation but neither have a larger number of patients treated only by surgery who have been observed for

TABLE 1

TREATMENT OF MALIGNANT NEURILEMOMA AT THE MEMORIAL HOSPITAL

Type of Treatment	No. of Cases
Total cases	31
Radical local excision	12
Radical local excision after preoperative x-ray therapy	1
Radical local excision plus postoperative x-ray theray	2
Postoperative x-ray therapy plus amputation	5
Primary amputation	4
Amputation after other forms of treatment here failed	1
Postoperative x-ray therapy after local excision elsewhere	1
Palliative x-ray therapy	3
Palliative amputation or excision	2

similar periods. Not infrequently malignant neurilemoma recurs after long intervals of inactivity in an irradiated area. This time interval may be similar in period to the time of recurrence after surgical removal. It appears from these observations that radiation therapy does not destroy the tendency toward development of a new tumor or prevent recurrence of the original one present. Therefore, from these data little can be expected from preoperative or palliative x-ray therapy on these tumors, and postoperative x-ray therapy should not be expected to keep the disease under control if it has not been completely eradicated by surgical measures.

The malignant peripheral nerve tumors must be treated by surgical measures either by radical local resection or by amputation when necessary. Each case represents a separate problem and the surgical procedure must be individualized to fit the local setting. One must consider treatment in the light of whether the procedure is for the extirpation of the primary lesion or for a recurrence and whether the tumor is of high or low grade malignancy by microscopic pattern. Thus a radical local excision might be applicable as the first attempt on a low grade tumor while an amputation might be a necessary procedure for recurrent tumor or for one showing a high grade of malignancy provided that a primary radical local excision could not eradicate the local lesion. With all factors considered, the successful end result is often determined by the first surgical procedure to be applied.

It is interesting to note the end results of a radical surgical approach and the causes of failure. Twenty-seven of our patients were treated surgically, fifteen by radical local excision and ten by amputation. One patient had an exploratory thoracotomy but the neoplasm was inoperable; another had a palliative hip joint disarticulation. By radical excision we mean that the tumor plus its bed and any attached nerve, bone, muscle or vessel must be excised *en bloc*. The nerves of origin must be sacrificed proximally and distally for a healthy margin from the tumor through grossly normal nerve tissue. Immediate microscopic study of frozen tissue sections at the time of excision is helpful in being certain that the line of nerve section is above the level of intraneural spread of the neoplasm. The resulting operative defect must be through normal tissues on all surfaces. A number of cases may require skin grafting in order to close the defect created by the wide removal of skin. On the extremities if a radical local excision does not meet all the requirements for excision through normal tissue, an amputation must then be carried out. In this material restoration of nerve, continuity has not been feasible at the primary operation because the sacrificed segment of involved nerve has been so long that transposition of the nerves plus positioning of the limb could not affect apposition of the nerve ends. The authors believe that the radicalism of the excision for prevention of local recurrence and cure of the disease is the prime surgical objective and limitation of the excision for purposes of restoration of nerve function should not be done. Cutler and Gross,[7] who classify all malignant nerve tumors as malignant neurofibromas contend, and the writers agree, that the malignant neurilemoma of grade 1 malignancy can be removed by radical local excision. They usually do not require treatment by amputation. Thus the excision need not be as radical providing the nerve of origin also is excised. A frozen section microscopic analysis at the time of surgery or a formal biopsy interpreted by an experienced pathologist before surgery is of immense value to the surgeon in planning his treatment of the borderline malignant group of nerve tumors.

TABLE 11

END RESULTS OF SURGICAL TREATMENT OF MALIGNANT NEURILEMOMA

A. Results of Radical Local Excision (Seventeen Cases)	
Local recurrence	3
No local recurrence	13
Recurrence after local excision here followed with amputation (Case 10)	1
End results	16
Lost to follow-up	5
Living with no recurrence	8
Died with no evidence of local recurrence (Case 29)	1
Died with local recurrence (Case 25, nine months; Case 17, 15 months)	2
Lived five years or more without evidence of disease	4
B. End Results of Treatments by Major Amputation (Eleven Cases)	
Palliative amputation	1
Recurrence in amputation stump (Cases 6, 13, 24)	3
Died in more than five years with lung metastases and no evidence of local recurrence—(Case 12 in eleven years)	1
Died in less than five years with local recurrence and/or lung metastases	7
Lived five years or more without evidence of disease	3

The results of treatment are given in Table 11. Thirty-one cases are available for analysis.

10A 10B 10C

FIG. 10. A, B, C, Malignant neurilemoma grade II of sciatic nerve; hemipelvectomy was performed; died in nineteen months of local recurrence and metastases.

The neoplasms in five cases (Cases 122, 23, 6, 27 and 29) were inoperable when first examined although one patient (Case 29) had an exploratory thoracotomy and another (Case 27) was subjected to a palliative hip joint disarticulation for an infected, bleeding thigh tumor.

Seventeen patients with malignant neurilemoma were treated by radical local excision, sixteen at this hospital and one treated elsewhere and followed up here. In reviewing the cases treated by radical local excision in which recurrence occurred and caused death (Cases 17 and 25) both tumors situated in the neck had local recurrences which precluded any further surgical treatment. The tumor in one patient (Case 10) was located in the upper extremity and recurred locally; an amputation was then performed. This patient has survived six years after that procedure. (Table II.)

Those patients treated by amputation (Cases 6, 13 and 24) followed by local recurrence in the stump present some features of interest. One patient (Case 6) had a local recurrence twenty-three months later in the stump of an amputation through the upper third of an arm. He refused interscapulothoracic amputation for seventeen months. This latter operation was followed with another recurrence after thirteen months in the operative site. This slow-growing tumor did not cause death until thirty-three months later. It is possible that earlier amputation at the shoulder girdle would have controlled the malignancy. One patient (Case 13) with local recurrence in a stump through the surgical neck of the humerus probably would not have benefited by further surgery which was advocated but refused. Another patient (Case 24) had a recurrence in the abdominal wall within nineteen months after a hemipelvectomy; the patient died three months later. The line of section of the lumbosacral nerve trunks was near the upper limits of the tumor despite the most radical type of surgery possible. (Fig. 10.)

From our material it would appear that results from local excision (four of seventeen lived five or more years; five other patients, when lost to follow-up, had lived on an average of twenty-five months; four other patients still under follow-up observation are living an average of twenty-six months) are better than those following amputation in which only three of eleven lived five years or more without recurrence. In the eleven instances of amputation,

however, seven represent failures first at local radical excision at this hospital or elsewhere. In the group of four amputees not previously treated by radical local excision there was not one patient who lived five years or longer without recurrence. However, each had a large, bulky, rapidly growing tumor, two in the upper and two in the lower extremity. (Cases 6, 7, 9 and 24.) On the other hand, three patients (Cases 5, 10 and 18) were saved by amputation when local radical excision had previously failed; another (Case 12) lived ten years before succumbing to metastases from the malignant neurilemoma. (Table III.)

TABLE III
FIVE-YEAR SURVIVALS AS DETERMINED BY OPERABILITY OF MALIGNANT NEURILEMOMA

Recurrent operable.... 5 cases	(Cases 4, 5, 10, 18 and 20)
Primary operable..... 1 case.....	(Case 14)
Surgery elsewhere..... 1 case.....	(Case 11)

TABLE IV
FIVE-YEAR END RESULTS IN THE TREATMENT OF MALIGNANT NEURILEMOMA

Total number of cases		31
Indeterminate group:		
Total number of indeterminate results		11
Dead as a result of other causes and without recurrence	1	
Lost track of without recurrence	5	
Patients followed up less than five years and still under observation	4	
Lost track of without recurrence over five years	1	
Determinate group:		
Total number minus those of indeterminate group		20
Failures:		
Total number of failures		14
Dead as a result of the tumor	13	
Lost track of with disease (probably dead)	1	
Living with recurrence	0	
Successful results:		
Free from disease after five years or more		6
Net five-year end results:		
Successful results divided by determinate group: 6/20	30 per cent	

Table IV summarizes the end results by all types of treatment.

All end results in the treatment of malignant tumors at this hospital follow the above scheme; therefore, the accepted end result here is 30 per cent "clinical five-year cures."

If the data are analyzed for factors other than the type of therapy used, it at once comes to mind whether the histologic type and grading of the tumor influence the end results. (Table V.) By classifying the tumors in the seven patients who died as a result of the neoplasm, these tumors were graded according to the Broders' classification into grades I, II, III and IV.

TABLE V
END RESULTS IN RELATION TO THE GRADING OF MALIGNANT NEURILEMOMA

End Results	Total Cases	Grading of Tumor			
		I	II	III	IV
Patients dying of uncontrolled malignant neurilemoma.....	13	2	7	4	0
Patients living five or more years without recurrence....	7	2	4	1	0

All seven patients who died with lung metastases while under observation had been subjected to amputation. Three patients (Cases 6, 9 and 24) had primary amputations while the other four (Cases 7, 8, 12 and 27) were subjected to amputation for recurrent or residual neoplasm. Two of these seven (Cases 6 and 24) in addition to lung metastases developed local recurrence in the amputation stump. The histologic grading of these seven tumors were: three cases, grade II, three cases, grade III and one case, grade I.

In one patient (Case 7) the malignant neurilemoma was classified as only grade I yet the patient died of pulmonary metastasis; this was an unexpected result as the majority of such tumors with similar histologic pattern may recur locally many times and the tumor become increasingly anaplastic in structure before metastases occur. These fatal blood-borne metastases appear to be related to the incidence of local recurrence and to the histologic grading of the tumor. Warren[50] has pointed out that patients with neurogenic fibrosarcoma exhibiting tumor giant cells survive a definitely shorter period than those without giant cells.

In this material there were fifteen patients who had locally residual tumors after prior treatment or recurrence in the operative site following excision. Thus it is obvious that the primary local excision or amputation is often inadequately radical. Recurrence offers a grave

prognosis not only regarding the likelihood of metastases but also with regard to a fatal issue from the disease. Thus adequate primary removal is of first importance as it is readily apparent in reviewing this material that persistence of the tumor shows a tendency to greater anaplasia in the succeeding recurrences thus giving a setting for fatal metastases from the more rapidly growing, more highly anaplastic growths.

TABLE VI
RELATIONSHIP OF NEUROFIBROMATOSIS TO END RESULTS IN MALIGNANT NEURILEMOMA

	No.	Per cent
Patients dying with uncontrolled malignant neurilemoma:		
Associated with neurofibromatosis	4	30
Unassociated with neurofibromatosis	9	70
Patients living five years or more without recurrence:		
Associated with neurofibromatosis	4	57
Unassociated with neurofibromatosis	3	43

From Table v it appears certain that the end results are definitely related to the anaplasia of the tumor.

The relationship of neurofibromatosis to malignant neurilemoma as it affects the end results is summarized in Table VI.

It has often been stated and written that patients with malignant neurilemoma occurring on the basis of frank von Recklinghausen's neurofibromatosis are infrequently cured. These data though based on a small series of thirty-one cases do not completely agree with this statement. Among the seven patients with clinical cures three had no stigmata of this disease; two patients had frank general neurofibromatosis and two others had the abortive or forme fruste type. Among the thirteen patients dying with uncontrolled malignant neurilemoma four had unquestioned neurofibromatosis and nine had no stigmata of the condition described in their clinical records.

It has been the authors' experience that those tumors arising in major nerve trunks are clinically more malignant. Only two patients of the clinical five-year cures had their tumors originating in major nerves, both having cancers of the median nerve. The other five arrested cases had tumors which were relatively superficial and had their origin in plexiform neurilemomas.

Of the thirteen patients dying of this disease nine of the tumors originated in named nerves or plexuses. In three the process was so extensive that in even these though appearing to arise on the basis of large plexiform neurilemomas the malignant tumors could have originated in the major nerves of the area, e.g., cervical plexus in Cases 16 and 17 and mediastinal nerves in Case 29.

COMMENTS

The review of this particular type of malignant tumor of peripheral nerves indicates that these neoplasms are found frequently with classic von Recklinghausen's neurofibromatosis or may occur in isolated instances in which even close examination will not reveal the patient to have any stigmata of the forme fruste type of neurofibromatosis. Regardless of this association the behavior of these malignant tumors is in no way different. It is a clinical fact that when more than one malignant neurilemoma occurs in a patient with von Recklinghausen's disease that patient is seldom cured. The explanation is possibly that in this disease although one tumor may be eradicated other nerves in the same or other regions have a tendency toward the same type of malignant transformation. This occasionally noted phenomenon would tend to support Hosoi's[19] opinion that nerves in the area or other regions will frequently assume the same degree of neoplasia. Although a local recurrence is assumed to be a residuum of the growth excised primarily, the possible explanation may be that other nerves in the location which had exhibited only the histology of a plexiform neurilemoma at the first operation at a later time became transformed into fully developed malignant tumors. It may be impossible to tell if such a neoplasm is truly an original lesion or an extension along a nerve trunk by direct growth or lymphatic dissemination.

We believe that to make a diagnosis of malignant nerve tumor of the type under discussion the tumor must be shown to arise in definite nerve tissues. Without this anatomicopathologic relationship, on pure histologic grounds, the malignant nerve tumors cannot be readily separated from various fibrosarcomas or leiomyosarcomas. This appears obvious in view of the fact that both Schwann

cells of the nerve sheath and fibroblasts can form reticulin or connective tissue fibers. So-called palisading of the nuclei appearing in malignant neurilemomas is also a characteristic of leiomyomas, leiomyosarcomas and fibrosarcomas.

The malignant nerve tumors of low histologic grading offer a good prognosis despite a frequent high recurrence rate. Those tumors with a high degree of anaplasia are almost invariably fatal because of the great frequency of metastases despite the most radical methods of extirpation. Therefore, the rate of curability is influenced by the local recurrence rate because succeeding recurrences most frequently show a higher degree of anaplasia. Occasionally the opposite is true, a recurrence may appear less malignant than the primary tumor. Although tumors with a structure which we diagnose as grade I malignant neurilemoma will metastasize, this is rare. The tumors of low grade malignancy and those located superficially are the most frequently cured. There was only one five-year survival in a patient with grade III anaplastic tumor in this series.

CONCLUSIONS

1. Malignant neurilemomas, neurogenic sarcomas, neurosarcomas and malignant schwannomas are synonymous terms for malignant peripheral nerve tumors that can be traced to the Schwann cells of the nerve sheath. These tumors are found in patients who may or may not have the classic or any abortive type of von Recklinghausen's disease. These tumors are so designated because of their origin from nerves arising either from named nerve trunks or their branches or in other benign nerve tumors. They are separated from other sarcomas of the soft somatic parts by their anatomic origin and less certainly by their histologic structure. They differ from the other sarcomas because of their tendency to proliferate along nerves.

2. A simplified classification of the common peripheral nerve tumors is presented.

3. The eradication of malignant neurilemomas can be effected only by radical surgery, either by radical local excision or amputation with generous sacrifice of the nerves from which they originate. Radical excision at the first attempt at eradication is often the only golden opportunity for permanent cure.

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DIAGNOSIS AND MANAGEMENT OF ECTOPIC PREGNANCY

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AMONG the abdominal emergencies observed in gynecology ectopic pregnancy is outstanding in importance not only from the standpoint of frequency but also because of the dire consequences when unrecognized or mismanaged.

The disease entity resulting from implantation of the fertilized ovum on tissue other than the endometrium lining the uterine cavity was described as early as the sixteenth century. During the twentieth century and especially during the last decade the literature on the subject has been voluminous. Nevertheless, there still remains a definite divergence of opinion as to proper management.

Furthermore, a necessary prerequisite for proper therapy is a high degree of diagnostic accuracy. Diagnosis is difficult because few individuals have the opportunity to see a sufficient volume of cases to develop a knowledge of the various clinical pictures which present themselves. The dramatic picture following an acute rupture with extensive intraperitoneal hemorrhage stressed by most textbooks and many papers on the subject is so typical that it rarely presents a diagnostic problem even to the young intern. However, there are a large number of cases in which no such typical picture exists either because rupture has not occurred or it occurred some days or even weeks before the patient came under observation. Not infrequently the intra-abdominal bleeding recurs at varying intervals with minimal amounts of blood loss and associated with short episodes of pain. These cases constitute the chronic type described so well by Atlee and more recently by Henderson and Bean. More attention must be directed to these obscure forms of ectopic gestation if the present ratio of correct diagnoses is to be increased.

Because of the foregoing facts this study was undertaken. The statistics presented represent 125 consecutive cases of extrauterine pregnancy treated on the gynecologic wards of the Jersey City Medical Center during the ten-year period 1940 to 1950.

Age. Inspection of Table I reveals that the youngest case in this series was nineteen years of age and the eldest forty-four. The highest incidence was found in the twenty-five through twenty-nine age range, this group comprising 36 per cent of the cases.

TABLE I

AGE INCIDENCE

No. of Cases	Age Groups
27	19 to 24
45	25 to 29
30	30 to 34
19	35 to 39
4	40 to 44

In a larger series reported by Beacham and his co-workers the greatest incidence for the Negro group occurred between the years twenty-one and thirty and in the white group the majority were in the twenty-six through thirty-five age range. Their youngest patient was fifteen years of age and the eldest forty-eight. It is apparent that the diagnosis of ectopic pregnancy must be considered at any time during the child-bearing age.

TABLE II

NUMBER OF PREVIOUS PREGNANCIES

No. of Cases	Gravida
27	0
31	1
27	2
17	3
10	4
5	5
6	6
1	7
1	8

Previous Pregnancies. In compiling the relative fertility of the 125 cases comprising this report Table II indicates that twenty-seven (21.5 per cent) had not been previously pregnant and ninety-eight had had one or more children. It is worthy of note that among the multigravida there were five quintigravidas, six sextigravidas, one septigravida and one octigravida. The conclusion is unmistakable that ectopic gestation can occur in the highly fertile female.

Eight of the patients had undergone laparotomy for proved previous ectopic pregnancy, an incidence of 6.4 per cent. This ratio is appreciably higher than the 3.6 per cent among 1,608 cases reported by Smith and the 3.4 per cent among 381 cases reported by the Beacham group.

Among our eight repeat ectopic gestations the shortest interval between the first and second episode was eight months and the longest was sixteen years.

The data regarding the duration of previous sterility is of especial interest since it is widely accepted that ectopic gestation is frequently preceded by a long period of involuntary infertility. The shortest period of previous infertility was four months, the longest interval twenty years. Eight of the patients had been delivered of a child less than one year before coming under observation for extrauterine pregnancy. Another eight cases had borne a child less than two years previously and seven had had an offspring within three years. A total of forty-four cases (35.2 per cent) exhibited a previous period of sterility of five years or less while only twelve cases (9.6 per cent) presented a history of previous sterility of ten years or longer.

It is apparent that in this series a long period of previous barrenness is not an outstanding finding and its absence should not be permitted to mislead the clinician. Its presence, however, should arouse in the mind of the physician a suspicion that ectopic pregnancy may be responsible for the clinical picture under consideration.

Schauffler, Whitacre and Bryan, and Siegler in separate communications have reported a high incidence of previous pelvic inflammatory disease and previous pelvic surgery as factors in the causation of ectopic pregnancy.

Thirty-four cases in this series gave a reliable history of previous pelvic inflammatory disease and thirteen had been subjected to a previous pelvic laparotomy, a combined incidence of 37.6 per cent. While this is significant, it falls far short of the seventy-eight per cent in 127 cases reported by Siegler.

Symptomatology. It has long been recognized that one of the chief assets in the diagnosis of ectopic pregnancy is a carefully taken history. We have further seen the value of taking a detailed history by the consultating physician directly from the patient rather than depend on the findings of the family physician or the house staff. This is not meant to infer incompetence on the part of the former but rather to emphasize that not infrequently a significant point will be uncovered which will direct the examiner's attention to the fact that ectopic pregnancy may be responsible for the clinical picture under consideration.

TABLE III
SYMPTOMATOLOGY

	No. of Cases
Abdominal pain	123
Previous to rupture	47
At time of rupture	76
Shoulder pain	31
Rectal pain	10
Delay in menses	85
Abnormal bleeding	92
Spotting	79
Menorrhagia	13
Fainting or syncope	51
Morning nausea	16

The most frequent subjective symptom in this series was pain. Table III reveals that 123 cases presented this as a chief complaint, an incidence of 98.4 per cent. The character of the pain varied considerably. This variation was apparent in respect to its intensity, its continuous or intermittent nature, its primary site and its referred site. The chief factors producing this variation were the ruptured or unruptured status of the tube, the amount of bleeding and the pain threshold of the individual.

Forty-seven patients complained of pain previous to the time of major rupture. This was described in a majority of the cases as mild in intensity, intermittent in nature and localized either to the right or left lower quadrant. Brady's interpretation that this pain is due to the distention of the tube by the growing ovum is feasible. There is probably an added factor in some cases. Litzenberg has drawn attention to the occurrence of intratubal hemorrhage without rupture of the tube. Since hematosalpinx is not a rare finding at operation, it is reasonable to believe that it is at times an additional factor in the production of pain encountered before tubal rupture.

Not infrequently an episode was described as more severe in intensity with generalized lower abdominal pain requiring bed rest for a few or more hours. These were interpreted as evidence of previous mild rupture with minimal amounts of intra-abdominal hemorrhage.

Seventy-six of the patients experienced no appreciable pain until the advent of rupture. The pain occurring with a major rupture varied in intensity but in a majority of cases was classified as severe. It was generally described as being sudden and sharp and was usually localized to the right or left lower quadrant at its onset. Almost invariably, however, the pain became generalized throughout the lower abdomen, a fact not difficult to accept since it is recognized that the pain at rupture is due to the reaction of the pelvic peritoneum to the outpouring of blood into the peritoneal cavity. A typical characteristic of the pain associated with rupture in ectopic pregnancy is that the patient can recall the exact moment at which the pain began. Physical exertion need not be a factor although the bathroom appears to be a frequent site.

TABLE IV
DURATION OF PAIN

No. of Cases	Time Interval
34	1 to 12 hr
16	12 to 24 hr
11	24 to 48 hr
16	2 to 7 days
11	1 to 2 wk
28	2 to 4 wk
7	4 to 16 wk

In thirty-one of the cases the hemorrhage was apparently of sufficient magnitude to cause diaphragmatic irritation and referred shoulder pain. Ten of the cases referred the pain to the region of the rectum.

A feeling of faintness or syncope is a rather frequent associated symptom at the time of rupture, being present in fifty-one cases (40.8 per cent). This symptom has added significance if it is ascertained that the patient is not usually subject to such attacks.

It is important to emphasize that patients will rarely volunteer the information that the symptoms of syncope and shoulder pain are present, and both of these tremendously important diagnostic signs must be extracted by direct questioning. This practice probably accounts for the higher incidence of these two symptoms in this series than generally reported.

That ectopic gestation does not always present an acute picture is demonstrated by Table IV which records the time interval between the onset of pain and the time at which the patient came under observation.

Fifty cases (40 per cent) presented a history of having pain of less than twenty-four hours' duration. Another eleven had experienced pain for a period of twenty-four to forty-eight hours. However, the remaining sixty-two cases (49.6 per cent) came under observation from two days to sixteen weeks after the onset of pain.

Abnormal vaginal bleeding was the second most frequently recorded symptom, ninety-two cases presenting this as a chief complaint, an incidence of 73.6 per cent. In seventy-nine of the cases the bleeding was described as an irregular spotting, the amount of blood loss varying but not exceeding the normal menstrual flow. In the remaining thirteen patients, however, the bleeding was profuse, even flooding, and was classified as a menorrhagia.

TABLE V
PHYSICAL FINDINGS

	No. of Cases
Abdominal tenderness	114
Rebound tenderness	55
Abdominal distention	33
Abdominal rigidity	18
Adnexal tenderness	99
Palpable adnexal mass	57
Pain on motion of the cervix	70
Shock syndrome	44
Flank dullness	21
Cervical softening	55
Uterine enlargement	49
Uterine softening	20
Breast signs	33
Palpable abdominal mass	4
Cullen's sign	2

Since a delay in menstruation is the symptom that is most likely to direct the physician's attentions to the possible existence of pregnancy, it is reassuring to find that eighty-five patients in this series had experienced such a delay. While the duration of the extended amenorrhea beyond the expected day of menses varied from a few days to four weeks or more, the most frequent period of delay was two to three weeks.

Morning nausea and vomiting characteristic of early pregnancy was recorded as present in only sixteen cases.

Positive Physical Findings. Table V reveals that abdominal tenderness was the most frequently occurring physical finding, only eleven cases failing to exhibit this sign at examination. In fifty-five of these cases there was sufficient peritoneal irritation to cause rebound tenderness of the lower abdomen.

Adnexal tenderness was found at pelvic examination in ninety-nine cases and in fifty-seven of these there was an associated palpable

adnexal mass. The soft, movable, sausage-shaped mass described by the older writers as typical of tubal gestation was an infrequent finding. Perforation and hemorrhage had caused a majority of the palpable masses to become fixed, indurated and irregular in contour. In four cases the mass had reached such proportions that it was palpable abdominally.

Although pain on motion of the cervix is a fairly prominent finding, being present in fifty-five cases, it is of little diagnostic significance because it is so commonly found in other pelvic disorders.

The shock syndrome characterized by pallor, cold clammy extremities, a rapid thready pulse and a falling blood pressure was recorded in forty-four cases. Its presence is indicative of a sudden, large and recent hemorrhage with which the normal compensatory mechanism is unable to cope or recurring lesser hemorrhages, the final episode resulting in a total blood loss beyond the compensatory efforts of the body.

Flank dullness was a relatively infrequent physical finding but it is well to point out that its presence is of great diagnostic value.

Objective signs of pregnancy such as softening and enlargement of the corpus uteri, cervical softening and breast signs were found with a sufficient degree of frequency to be of real value in arriving at a proper diagnosis.

Cullen's sign consisting of a bluish discoloration around the umbilicus and always indicative of intraperitoneal hemorrhage was found in two cases.

DIAGNOSTIC PROCEDURES

The atypical form of ectopic gestation usually presents a formidable diagnostic problem and every available clinical and laboratory diagnostic aid must be utilized in an attempt to arrive at a correct diagnosis.

The red blood count is frequently the motivating factor in directing the clinician's thoughts to the probable existence of tubal pregnancy. A degree of anemia more severe than can be accounted for by external blood loss is presumptive evidence of concealed intraperitoneal hemorrhage. In this series red blood cell counts of between one and two million were found in three cases and counts of between two and three million were recorded in fifty-two cases. Equivalent hemoglobin values were the rule.

A leukocytosis was found to be a rather prominent accompanying feature, its incidence being 70.1 per cent. In forty-eight cases the white cell count was between 9,000 and 14,900. In an additional twenty-three cases the count was between 15,000 and 19,900 and in eighteen cases the leukocyte count was above 20,000, the highest recorded count being 37,000.

A pyrexia of any large extent was conspicuously absent. In a great majority of cases (85.6 per cent) the preoperative rectal temperature was less than 100°F. In only eighteen cases was the temperature rise above 100°F., ranging between 100° and 101° in sixteen patients and between 101° and 102° in the remaining two.

As might be expected low blood pressure was a relatively frequent finding, 53.6 per cent presenting a systolic pressure below 100 mm. of mercury. In twenty-eight cases the systolic blood pressure was recorded between 80 and 100, in twenty-three cases between 60 and 80, in nine between 40 and 60, in two between 30 and 40 and in five cases it was recorded as 0.

A Friedman test for pregnancy was used in thirty-one cases. In twenty-three of these the result was positive and in eight negative, a ratio of almost 3 to 1. It is apparent that this biologic test is a valuable diagnostic aid in the non-urgent case.

Since it is generally recognized that functional chorionic tissue is a prerequisite to a positive Friedman test, an attempt was made to correlate our findings with the duration of symptoms. The duration of previous symptomatology did not appear to have any constant influence on the result. For example, one patient whose symptoms had existed for forty-seven days had a positive Friedman test whereas a patient whose symptoms were only of three days' duration had a negative result.

Decidual tissue either in the form of casts or fragments and proved by histologic study was found in ten cases. The presence of such tissue unaccompanied with chorionic villi must be considered strong evidence in the support of the existence of an extrauterine gestation. Novak has stated that expulsion of a decidual cast in cases of tubal pregnancy signifies the death of the embryo but a considerable interval, often several days, may elapse before the cast is thrown off. How long after embryonic death the Friedman test remains positive is a matter for conjecture, but it is of interest that in one of our cases the Friedman test was

positive from a urine specimen obtained two days after expulsion of a decidual cast.

Much has been written about the value of sedimentation rates as an aid in diagnosis. In our experience the presence of a rapid sedimentation time did not prove to be an important factor in arriving at a positive diagnosis.

TABLE VI
PREOPERATIVE DIAGNOSIS

	No. of Cases
Ectopic pregnancy	152
Pelvic inflammatory disease	5
Fibromyoma uteri	3
Ovarian cyst	1
Parovarian cyst	1

While hematocrit determinations are of distinct value in determining the extent of blood loss, it is our belief that a rapid and reliable method of determining blood volume will prove the only solution to a true evaluation of the amount of blood needed to restore equilibrium.

Aspiration of the pouch of Douglas to determine whether there is free blood in the pelvis may establish the diagnosis. This simple but effective procedure has proved of especial value in the very acute case when time is such an important factor.

DIAGNOSIS

In order to establish a true evaluation of our diagnostic accuracy all cases bearing either a preoperative or a postoperative diagnosis of ectopic gestation were considered. A total of 162 such cases were tabulated. Table VI records the provisional preoperative diagnosis for which the patients were subjected to surgery.

In 152 cases the diagnosis made preoperatively was ectopic pregnancy and in 115 of these the diagnosis was established as correct at operation. In the remaining ten proved cases ectopic pregnancy was not suspected, pelvic inflammatory disease being the chief source of error. In the three cases diagnosed as fibromyoma fibroids were present in addition to ectopic pregnancy.

Table VII depicts the breakdown of diagnoses as established after operation. In the thirty-seven cases in which other conditions were found, nineteen were pelvic inflammatory disease. Intrauterine pregnancy with complicating features were responsible for six incorrect diagnoses. In the remaining twelve cases conditions associated with intraperitoneal hemorrhage were the chief source of error.

Our diagnostic accuracy of 70.9 per cent compares favorably with most reports in which similar methods of evaluation have been used. Marchetti, Kuder and Kuder report a series in which the condition was correctly diagnosed in 124 of 141 proved cases but was thought to be present in 219, resulting in a diagnostic accuracy of 56.6 per cent.

TABLE VII
POSTOPERATIVE DIAGNOSIS

	No. of Cases
Ectopic pregnancy	125
Pelvic inflammatory disease	19
Intrauterine pregnancy with bleeding	6
Parovarian cyst	2
Ruptured spleen	2
Hemorrhagic paralutein cyst	2
Ovarian cyst with torsion	1
Ruptured graafian follicle with bleeding	1
Ruptured uterus	1
Functional bleeding	1
Appendicitis	1
Intestinal obstruction	1

TREATMENT

Once the diagnosis of ectopic pregnancy has been established the indication for immediate operation is clear. Not infrequently the indication for operation is compelling when the diagnosis, although not positive, is highly presumptive. In the suspected case in which the findings are not sufficient to warrant laparotomy immediate hospitalization should be advised and properly typed and cross-matched blood made available while further observation and diagnostic studies are made.

Although ruptured ectopic cyesis is an operative emergency, we believe a primary principle in proper management is the adequate preoperative treatment of shock. We are in accord with the viewpoints of Schauffler and Falls that restoration of blood and establishment of at least partial equilibrium are preoperative necessities when the patient is in shock or near shock levels. Pratt, Brady and Jarcho are among those who advocate that blood should be withheld until bleeding is controlled at operation. Pratt states that no attempt should be made to raise the patient's blood pressure to normal as this will only provoke further hemorrhage, but enough fluids should be given preoperatively to keep the systolic blood pressure between 80 and 100 mm. of mercury. With this school of thought we heartily disagree. There is no evidence to indicate

that increasing the blood pressure with transfusion will necessarily result in renewed hemorrhage. It is our custom to give blood preoperatively to every patient who presents signs indicative of moderate or severe blood loss. The fact that such patients almost invariably show improvement in their shock level, as well as the fact that it is not uncommon to find an absence of active bleeding at operation, lends weight to the rationale of such therapy. A sufficient volume of blood is used to bring the systolic pressure level to at least 100 mm. of mercury and preferably higher. If we have erred in this regard, it has been in the direction of using too little blood rather than too much. Shock resulting from hemorrhage can be combated most effectively by replacement with whole blood. Infusions and plasma are at best poor substitutes and serve only as a temporary medium of therapy until blood properly typed, cross-matched and with proper Rh determination becomes available.

TABLE VIII
OPERATIVE FINDINGS

	No. of Cases
Ruptured	109
Unruptured	9
Tubal abortion	7
Right tubal cyesis	62
Left tubal cyesis	63

In this series sixty patients were given blood preoperatively and seventy-eight patients were given transfusions during operation. To those given blood preoperatively the average amount given was 900 cc. The average amount of blood used during operation was 670 cc.

Table VIII reveals that 109 of the cases were found ruptured at operation. Of these 107 were of the isthmic or ampullary variety and only two were of the uncommon interstitial type. In all of the nine unruptured cases the pregnancy was situated either in the isthmus or the ampulla of the fallopian tube. In the remaining seven cases a tubal abortion was found at operation. The right salpinx was the site of gestation in sixty-two cases, the left in sixty-three. No instance of twin tubal pregnancy was found although the opposite tube and ovary were inspected routinely.

At laparotomy in eighty-eight of the cases a unilateral salpingectomy was performed. An additional thirty-two cases were subjected to a unilateral salpingo-oophorectomy. The majority of these were of the so-called chronic type in which the pathologic disorder found made it impossible to salvage the ovary on the involved side. Hysterectomy was done in three cases because of the presence of fibromyoma of the uterus in association with ectopic pregnancy.

TABLE IX
OPERATIVE PROCEDURES

	No. of Cases
Salpingectomy	88
Salpingo-oophorectomy	32
Hysterectomy	3
Corunal resection	2
Resection of ovary	6
Dermoid cystectomy	1
Myomectomy	3
Appendectomy	2

In the two cases of interstitial cyesis a cornual resection was performed.

The paucity of additional operative procedures as shown in Table IX is indicative of our belief in regard to multiple operations on a woman who has a ruptured ectopic gestation. It is poor surgical judgment to subject a patient who is close to shock level to any additional operative procedure. Only occasionally do the findings justify a change in this policy.

The majority of the patients were given inhalation anesthesia. Cyclopropane alone or combined with ether, curare or nitrous oxide were the agents used. In a smaller number spinal anesthesia was administered, novocain, pontocaine or a combination of both being used. The type of anesthesia selected was determined by the anesthetist after careful evaluation of the condition of the patient.

The one death in this series occurred during operation. It is worthy of note that this patient was given intravenous fluids preoperatively but blood was withheld until the time of operation. She was given a spinal anesthetic. It is our belief that the inadequate management of shock preoperatively and the choice of anesthesia were contributing factors in this fatality. No other deaths occurred from ectopic gestation with or without surgery during the period this report represents. The mortality of 0.8 per cent compares favorably with all recent reports, whether large or small.

The factors contributing to this low mortality were the adequate treatment of shock with blood before operation, the establishment of a hospital blood bank making blood readily available, good anesthesia and the paucity of multiple operations.

SUMMARY AND CONCLUSIONS

One hundred twenty-five cases of proved ectopic pregnancy have been managed on the Gynecological Service of the Medical Center in Jersey City between 1940 and 1950.

The highest incidence was found in the age range from twenty-four through thirty-two, this group comprising 58 per cent of the cases.

Only 21.5 per cent of the patients had not been previously pregnant. A high degree of fertility in the remaining group was not uncommon.

Of the patients, 6.4 per cent had undergone laparotomy for proved previous extrauterine gestation.

A long period of previous sterility was not an outstanding finding.

Abdominal pain, abnormal vaginal bleeding and delayed menses form a triumvirate of symptoms that were present in a great majority of cases.

Shoulder pain and syncope are important diagnostic signs and their presence must frequently be ascertained by direct questioning.

The atypical type of ectopic pregnancy presents a formidable diagnostic problem and a carefully taken history with a thorough physical examination is essential for correct diagnosis.

The red blood count, white blood count, Friedman test for pregnancy, aspiration of the cul-de-sac and the presence of decidual tissue are important diagnostic aids.

The suspected case of ectopic cyesis should be hospitalized and compatible blood made available while further observation and tests either confirm or rule out the diagnosis.

Factors contributing to the low mortality rate were the adequate treatment of shock with blood before operation, the establishment of a hospital blood bank making blood readily available, good anesthesia and the paucity of multiple operations.

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PARATHYROID ADENOMA

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THE first successful surgical removal of a parathyroid adenoma by Mandl in 1925 aroused widespread clinical interest in hyperparathyroidism. In 1880 Sandstrom first described and named the parathyroid glands and Askanazy in 1904 was the first to associate skeletal lesions with the finding of a parathyroid tumor. Although hyperparathyroidism is of relatively rare occurrence, its recognition is of the utmost importance since the variety of sequelae which often follow in its wake may lead to serious disability or death.

The distinct clinical entity of hyperparathyroidism has been divided into two types, primary and secondary.[1] Primary hyperparathyroidism signifies a state in which the production of parathyroid hormone exceeds the need. Secondary hyperparathyroidism signifies the condition in which the greater than normal production of parathyroid hormone is a compensatory response to an increased demand, i.e., in rickets, osteomalacia, calcium deprivation due to diet, pregnancy, lactation and chronic nephritis.[2]

Primary hyperparathyroidism may result from a single adenoma, multiple adenomas, hypertrophy and hyperplasia of all parathyroid tissue or from carcinoma of one of the parathyroids. In this connection through 1946 sixty-three patients with proved hyperparathyroidism had been observed at the Mayo Clinic.[3] In fifty-nine of the sixty-three cases adenomas were found; diffuse primary hyperplasia was present in the remaining four cases. In forty-four of the first fifty cases of hyperparathyroidism at the Massachusetts General Hospital[4] parathyroid adenomas were responsible; the remaining six cases were the result of diffuse hypertrophy and hyperplasia.

Embryologic and Anatomic Features. The parathyroid glands are derived from the third and fourth pairs of pharyngeal pouches.[5] Each of the inferior parathyroid glands, developing as it does from the dorsal aspect of the third pharyngeal pouch, is known as parathyroid gland III. The anlage of the inferior parathyroid gland arises in close association with the thymic primordium and migrates caudally, attached to the young thymus and lateral to the developing superior parathyroid and thyroid glands. Its descent usually terminates near the inferior pole of the thyroid gland although it may be carried with the developing thymus into the anterosuperior mediastinum. The surgical significance of the embryologic descent of the inferior parathyroid gland becomes apparent when it is realized that at operation the gland may be found at any level in the visceral compartment of the cervical fascia from the upper border of the larynx to the anterosuperior mediastinum and, indeed, into the latter at times.[3] The inferior gland is usually located in association with the posterolateral surface of the thyroid lying, as a rule, adjacent to the inferior pole near the branches of the inferior thyroid artery.

The superior parathyroid glands, originating from the fourth pair of pharyngeal pouches, are termed parathyroid glands IV. These glands arise in close association with the postbranchial bodies which represent the lateral anlage of the thyroid gland. When the latter merge with the lateral lobes of the median thyroid primordium, the superior parathyroids usually become attached to the thyroid capsule. The superior parathyroid often is situated posteriorly and may lie on the pharynx or esophagus rather than directly upon the thyroid gland. Although it is commonly thought that the gland is located at the superior pole of the thyroid, it is most often found at the junction of the upper and middle thirds of the thyroid, located posteromedially in relation to the latter. This parathyroid gland may be found at any point between the upper level of the larynx and the lower pole of the thyroid gland in the area limited anteriorly by the deep layer of cervical fascia and posteriorly by the prevertebral fascia.[3] As a rule the superior parathyroid gland is more readily identified than the inferior due to the limited extent of embryologic descent of the superior parathyroid gland.

Each parathyroid gland measures 6 to 7 mm. by 3 to 4 mm. by 1.5 to 2 mm. and weighs 25 to 35 mg. Although four glands are usually present, the number may vary from two to six or more. The gland is soft, having a thin capsule which contains a fine network of branching vessels. As a result of the inherent softness of the gland its shape is largely determined by the surrounding structures. Thus it may be flattened if it is molded over the surface of a firm structure like the thyroid; yet when the gland is located in loose or areolar tissue, an oval form is assumed. The gland varies in color depending upon the fat content. Prior to puberty it consists of chief cells and has a characteristic coffee-brown color. From puberty until the age of about forty the fat content steadily increases and consequently the color of the gland assumes a yellowish hue. The fat content then remains fairly constant during middle age and does not increase with old age. It is of interest that small parathyroid adenomas usually retain most of the characteristics of the normal parathyroid gland whereas the larger adenomas are more apt to be molded or distorted by surrounding structures.

The cell arrangement varies from large continuous masses to anastomosing columns and cords. The normal principal or chief cell, which measures 6 to 8 microns in diameter and is polyhedral in shape, is poorly outlined and contains a large, rounded nucleus which constitutes more than one-half the cell volume. The cytoplasm is usually scant. It may be so much so that the cell is spoken of as being vacuolated (exhibiting an unstained area of varying width about the nucleus). In cases in which complete vacuolization is present the term "water clear" or "wasserhelle" is used. This cell is more sharply outlined than the chief cell and is considerably larger measuring 10 to 15 microns in diameter. The nucleus eccentrically located is usually more hyperchromatic according to Castleman and Mallory[6] who have made extensive pathologic study of the parathyroid. The pale oxyphil and dark oxyphil cells are present at times.

Pathology of the Parathyroid Adenoma. Cell types which are normally present in the parathyroid gland are also found in parathyroid adenomas in varying distribution.[7] The cells, as a rule, are arranged in sheets or masses through which a rich vascular network ramifies in a relatively delicate connective tissue stroma. However, in certain adenomas follicle-like structures and cystic spaces are found but usually make up only a small portion of the tumor. The chief cell predominates with a varying percentage of transitional cells, pale and dark oxyphil cells. Castleman and Mallory[6] regard the chief cell as the basic fundamental cell from which the other types are derived. Fairly often giant hyperchromatic nuclei are noted. Wasserhelle cells are present to varying degrees in certain parathyroid adenomas. This cell, as indicated, is considered a variant of the chief cell. From the pathologic point of view one of the most important considerations is the ability to differentiate at the time of operation between parathyroid adenoma and hyperplasia and hypertrophy[8] of parathyroid tissue. This may be readily accomplished by the use of frozen section technic in the hands of a qualified pathologist. In certain adenomas the pleomorphism of cells, the finding of mitoses and invasion of the capsule are considered by a minority of pathologists as indications of a malignant character. The majority, however, believe that even with these findings the parathyroid adenoma is essentially a benign tumor. Only four cases of unquestioned carcinoma of the parathyroid gland associated with hyperparathyroidism have been reported according to Albright and Reifenstein.[4]

Pathologic Physiology. The parathyroid adenoma exerts a profound effect on the bodily economy as a result of the excessive production of parathyroid hormone. Although the effects of this increased secretion are well known, the mode of action is debated.[9] In this connection two schools of thought prevail. Collip advocates direct action of the hormone upon the bone structure, with resultant dissolution of bone and secondary changes in the electrolyte pattern. On the other hand, Albright believes the primary action of the hormone is upon the electrolytes in the fluids of the body and any bone changes which may follow are actually secondary to the chemical alteration. As a result of this action the following changes occur in the sequence given: hyperphosphaturia, hypophosphatemia, hypercalcemia and hypercalciuria. On the other hand, in hypoparathyroidism these four cardinal metabolic changes occur: (1) there is a decrease first in the phosphorus excreted in the urine; (2) the serum phosphorus is elevated; (3) the level of serum calcium falls; (4) there is a decrease in

the excretion of the calcium in the urine. All degrees of hyperparathyroidism may be observed and the milder the degree the less the abnormal chemical findings in the blood. From a clinical point of view, however, mild hyperparathyroidism may result in great disability or death; hence the early recognition of this abnormal state is important.

Clinical Considerations. Although adenomas have been removed from patients aged fourteen to seventy-seven years, the disorder is most commonly encountered between the ages of thirty and sixty years. It is found more often in females than in males and statistical reviews reveal that the average duration of symptoms prior to discovery of the adenoma ranges from five to seven years, evidence of the rather insidious onset and course of the disorder.

Symptoms due to hyperparathyroidism are logically divided into the following groups: (1) those referable to the skeletal system; (2) those referable to the urinary tract; (3) those referable to hypercalcemia *per se*.

It should be remembered that even in some cases of severe hyperparathyroidism there is no evidence of bone disease. In hyperparathyroidism the bone disease when present is the result of increased absorption rather than decreased formation of bone. The increased metaplasia of bone is reflected by a rise in the serum alkaline phosphatase. Skeletal decalcification of all degrees may be encountered.[10,11] Most commonly von Recklinghausen's disease of bone (osteitis fibrosa cystica) occurs in which cysts and tumors of variable size are superimposed upon generalized skeletal decalcification. Skeletal involvement may take the form of diffuse osteoporosis. The osteoclastoma (benign giant cell tumor) proved by biopsy may be the first evidence of hyperparathyroidism. This tumor when located in the jaw is called an epulis but not every epulis is due to hyperparathyroidism. All types of bone deformities may be encountered including spontaneous fractures, collapse of the vertebral bodies and bending of the long bones. In a review of sixty-three cases at the Mayo Clinic by Black[3] generalized osteitis fibrosa cystica was found in approximately 40 per cent of the cases. Urinary lithiasis, on the other hand, was found in more than 70 per cent of the cases.

In recent years the importance of urinary complications in hyperparathyroidism has been widely recognized.[12–16] Increased excretion of calcium and phosphorus usually results in symptoms of polyuria and polydipsia which at times have resulted in a mistaken diagnosis of diabetes insipidus. Due to hypercalciuria and hyperphosphaturia the danger of formation of urinary calculi is ever present. Deposition of calcium may take the form of nephrolithiasis or nephrocalcinosis, with resultant varying degrees of renal insufficiency.

Hypercalcemia *per se* is manifested by such symptoms as general malaise, asthenia and vague muscular pains and aches which are associated with a decrease in neuromuscular excitability. This is just the reverse of the increased neuromuscular excitability occurring in hypocalcemia (such as that occurring in parathyroid tetany). The serum calcium level may rise as high as 18 mg. per cent. The normal serum calcium value is 9 to 11 mg. per 100 cc. and the normal phosphorus level is 3.2 mg. $\pm$ 0.5 mg. In addition to the aforementioned symptoms others of a non-specific nature such as anorexia, indigestion, constipation and nausea and vomiting are often present.

Although the usual case of hyperparathyroidism runs a rather chronic course, acute attacks may occur.[17] This state, referred to as hyper-hyperparathyroidism, presents a clinical picture which closely parallels that resulting from acute parathyroid intoxication in the experimental animal. The train of events is as follows: a rapidly increasing serum calcium level, inspissation of the blood, failure of urinary phosphate excretion, increase in the serum phosphorus, combined high serum calcium and high serum phosphorus and, finally, precipitation of calcium phosphates into the tissues and chemical death, as outlined by Albright.[18] In rare instances acute parathyroid intoxication may occur spontaneously. More often improper therapy (i.e., the use of a high calcium diet in a patient with hypercalcemia) precipitates this disorder. To avoid the occurrence of this acute state early surgery in hyperparathyroidism is recommended. However, once the condition has occurred continuous intravenous saline and a low calcium diet are measures of value.

In establishing the diagnosis of hyperparathyroidism the symptoms and findings outlined previously should be borne in mind. Special blood chemistry studies including calcium, phosphorus and alkaline phosphatase determinations are indicated. Each patient who presents renal lithiasis should be investigated for

the possibility of hyperparathyroidism. The Sulkowitch test has proved extremely useful in estimating the degree of urinary calcium excretion. The Sulkowitch reagent containing oxalic acid is so buffered that upon addition to urine the calcium in the urine is promptly precipitated as calcium oxalate producing a white cloud. The density of the cloud formation is indicative of the amount of calcium in the urine and thus a reflection of the calcium balance of the body. Normally a light cloud results. If there is no cloud, hypocalcemia is present (the serum calcium is less than 7.5 mg. per cent). On the other hand, if a heavy cloud occurs, the serum calcium is above 10.5 mg. per cent. In certain instances in which the serum calcium level is only slightly elevated or is normal it is advisable to perform careful determination of the calcium excretion in the urine.[19,20] A neutral low ash calcium diet is administered and twenty-four-hour urine specimens collected. An excretion of urinary calcium of 150 mg. or above per day is high and suggests a negative calcium balance.

TREATMENT

The treatment of hyperparathyroidism is surgical.[21–25] Medical therapy produces only transient benefit. Although a negative calcium balance can be prevented and further bone disease arrested by the use of a high calcium intake, such excessive ingestion of calcium may precipitate parathyroid poisoning and should be avoided. Milk and cheese should be eliminated from the diet and fluids should be forced prior to operation. X-ray therapy has been attempted upon numerous occasions but is of no avail.

Proper surgical treatment is the result of close cooperation of internist, pathologist and surgeon. The diagnosis should be without question before operation[26] for the proposal to operate in order to make the diagnosis is fraught with dire consequences. Thorough familiarity with the embryologic and anatomic background of parathyroid glands is essential since the parathyroid adenoma may be found at any point over a wide area. Repeated emphasis has been laid upon careful, meticulous dissection in order to avoid blood-stained tissues. The adenoma itself exhibits a wide variation in size. In a series reported by Norris[7] the smallest adenoma weighed 0.4 gm. and the largest 120 gm. Adenomas occur approximately equally on the two sides of the neck but involve the inferior parathyroid gland four times more frequently than the superior parathyroid. Of the 10 per cent of adenomas located in aberrant positions 30 per cent are found in the mediastinum.

The sequence of the various steps during cervical dissection is of little moment as long as some systematic plan is followed. Each parathyroid should be located. The superior glands are usually more readily identified than the inferior. If a tumor is not found during the cervical dissection, complete exploration of the posterosuperior mediastinum should be accomplished. Once the tumor is located if there is any question as to its exact nature a small segment should be taken for biopsy. By means of immediate frozen section distinction can readily be made between parathyroid adenoma and diffuse hyperplasia. In approximately 6 per cent of cases hyperparathyroidism will be found due to hyperplasia and hypertrophy of all the parathyroid tissue. In such instances subtotal excision of all but 30 to 200 mg. of the hyperplastic tissue is recommended. Under no circumstances should a normal parathyroid be removed. If the frozen section diagnosis confirms the presence of an adenoma, total removal of the tumor is advocated. If a patient has very extensive skeletal involvement with a high serum alkaline phosphatase level, subtotal resection of the adenoma is recommended by some[4] since complete correction of the hyperparathyroid state will result in severe postoperative tetany which may be difficult if not impossible to control. Also, if a secondary operation is undertaken and it is known that normal parathyroid glands have been sacrificed previously, subtotal resection of the adenoma is advisable.

If thorough cervical and posterosuperior mediastinal exploration have failed to reveal the adenoma, the wound should be closed and the patient's course closely followed. If the clinical picture and laboratory findings remain as before operation, reoperation will be required. Careful exploration of the anterior mediastinum is performed through a sternal-splitting incision. Comprehensive reviews of the operative technic relative to the management of parathyroid adenomas are presented by Churchill[27] and Cope.[28]

Hypoparathyroidism occurring during the immediate postoperative period is attributed

to hypofunction of the remaining normal parathyroid glands and to the sudden shift of the calcium and phosphorus levels in the blood toward normal. Tetany when it does occur is usually mild and transient although it may be severe as in those cases with extensive decalcification of the skeleton and an associated high alkaline phosphatase level. In extremely severe cases therapy consists of continuous intravenous administration of calcium gluconate. The therapy for other cases will depend upon the degree of severity but in general the following procedures are recommended: The administration of 10 cc. of a 10 per cent calcium gluconate solution intravenously usually affects a dramatic response which, however, is transient. Parathyroid extract should be started and may be given daily as necessary. Calcium lactate is administered by mouth together with lactose. If the tetany does not promptly respond to these measures, dihydrotachysterol (AT-10), an irradiated product of ergosterol, is used. This is an oily solution and is given by mouth daily in appropriate doses. In some cases, especially following secondary operative procedures, permanent tetany may ensue and calcium and AT-10 must be used indefinitely.

The skeletal changes if present are favorably affected following removal of the parathyroid adenoma. Recalcification of the skeleton occurs, particularly in the milder cases. However, if marked decalcification is present with, for example, collapse of the vertebral bodies with associated nerve-root pain, the response to parathyroidectomy will not be as favorable. It is of paramount importance to recognize hyperparathyroidism early in order to prevent the occurrence of advanced skeletal changes which produce such marked disability.[29] Removal of the parathyroid adenoma halts the deposition of calcium salts in either the renal parenchyma or the renal pelvis. These changes, however, are for the most part irreversible. As a matter of fact, if extremely severe renal insufficiency is present, death may ensue in spite of surgery. Again the need for early recognition and prompt surgical therapy is emphasized. Marked improvement is noted in the symptoms associated with the increased blood calcium *per se*. Non-specific symptoms including anorexia, constipation, nausea, vomiting, vague muscular aches and pains and lassitude related to the decreased excitability of the neuromuscular system are relieved.

CASE REPORTS

CASE 1. A twenty-five-year old soldier was admitted to the Urologic Section of Walter Reed General Hospital, Army Medical Center, Washington, D. C., on December 13, 1946, as a transfer from a nearby station hospital with tentative diagnoses of subacute cystitis and bilateral renal calcinosis. For six weeks previously the patient had noted increasing malaise, fatigue, anorexia, constipation, polydipsia and low back discomfort. Two weeks prior to admission severe bilateral costovertebral pain with associated hematuria appeared.

Physical examination of the patient upon admission was essentially negative with the exception of an artificial left eye. Complete blood count and clotting and bleeding times were normal. Urine examination revealed a relatively fixed specific gravity, with the presence of numerous red and white cells on high power field examination. Blood chemistry determinations were as follows: urea nitrogen 7.9 mg. per cent, blood sugar 117 mg. per cent and blood chloride 530 mg. per cent. The serum phosphorus was 2.86 mg. per cent with a normal of 3 to 4, and the serum calcium was 14 mg. per cent with a normal of 10 to 12 on December 24, 1946. A diagnosis of chronic cystitis cystica was made following cystoscopic study. Renal function studies revealed moderate impairment and retrograde urograms showed no evidence of calculi in the pelves or ureters. Scattered throughout the parenchyma of each kidney, however, was a large number of small calcific deposits. (Fig. 1.) Repeat calcium and phosphorus determinations were as follows: calcium 14.8 mg. per cent and phosphorus 2.94 mg. per cent on December 30, 1946. The patient was later transferred from the Urologic to the General Surgery Section.

On January 29, 1947, operation was performed through a low collar type of incision (Fig. 2) with division of the prethyroid muscles on each side thus affording adequate exposure of the entire thyroid gland. In the region of the inferior pole of the right lobe of the thyroid situated just adjacent to the descending branch of the inferior thyroid artery a discrete, ovoid, grayish brown, slightly lobulated mass measuring 1.5 by 1 cm was found. The right recurrent laryngeal nerve was identified as it lay dorsal to this mass. Further search revealed a normal right and left superior parathyroid

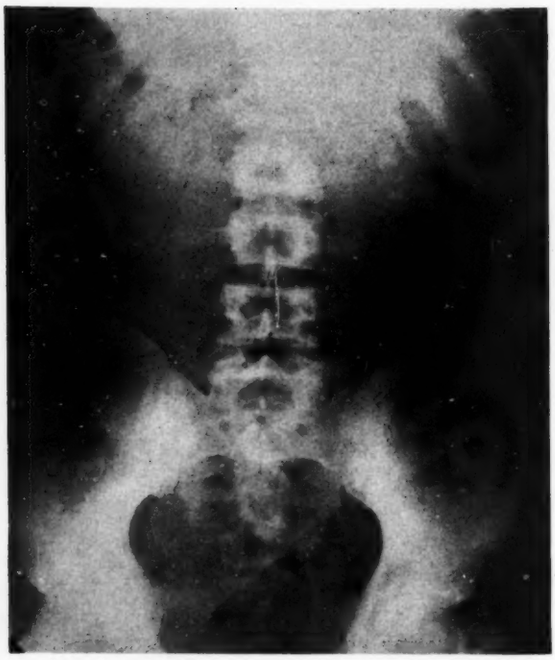


FIG. 1. Case 1. Flat plate x-ray of abdomen showing bilateral renal lithiasis.

FIG. 2. Case 1. Photograph of patient two weeks after operation illustrating low collar type incision.

gland. In the region normally occupied by the left inferior parathyroid there was a 1.5 by 1 cm., rounded, somewhat flattened, lobulated, reddish brown structure lying directly over the left recurrent laryngeal nerve. Each of the previously named masses was independent of the thyroid gland itself. A small section of the right-sided tumor was obtained for immediate pathologic study and frozen section examination revealed a parathyroid adenoma. The entire tumor on the right was removed and seven-

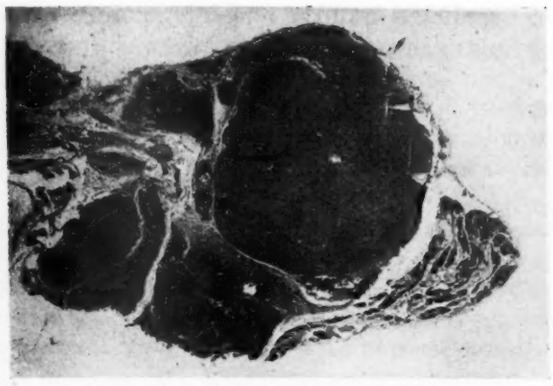


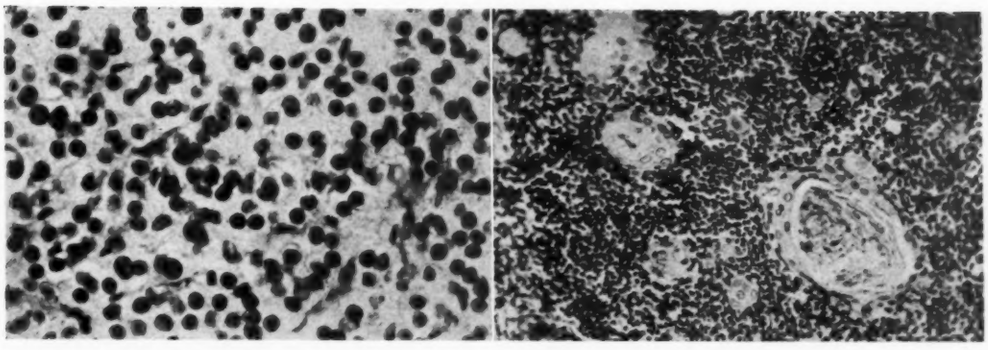
FIG. 3. Case 1. A periphery of normal, lobulated parathyroid tissue surrounds the centrally placed parathyroid adenoma. × 23. (Army Institute of Pathology.)

eighths of the left-sided tumor were resected. The wound was then closed in the usual manner.

The pathologic report of the right-sided specimen was as follows: Grossly, the specimen consisted of an irregularly bean-shaped, encapsulated mass measuring 1.5 by 1 by 0.4 cm. which upon sectioning appeared somewhat firm and slightly nodular. Microscopically, sections exhibited a periphery of essentially normal, lobulated parathyroid gland. In the central portion two well defined, circumscribed nodules of closely packed cells (Fig. 3) were seen, the majority of which were ovoid to polygonal and had a vacuolated, pale eosinophilic cytoplasm and ovoid, finely stippled nuclei. (Fig. 4.) Approximately 2 per cent of the cells were polygonal to fusiform in shape, having a homogeneous, deeply staining, esoinophilic cytoplasm and small, sharply defined, oval nuclei. The stroma was sparse throughout the nodule and formed only a fine reticular network which was rather highly vascular. Diagnosis was adenoma of the right parathyroid gland.

The pathologic report of the left-sided specimen was as follows: Grossly, the specimen consisted of a button-shaped, encapsulated mass measuring 1.2 by 1 by 0.3 cm. Microscopically, sections through the specimen showed sparsely scattered lymphoid tissue throughout which were rather prominent Hassall's corpuscles. (Fig. 5.) The diagnosis was essentially normal thymic tissue.

During the immediate postoperative period symptoms of hypoparathyroidism developed which were promptly corrected by the administration of 10 cc. of 10 per cent calcium gluconate intravenously. The patient was immediately placed on a high vitamin D intake and in



4 5

FIG. 4. Case 1. Note the compact grouping of the chief cells with their large hyperchromatic nuclei and the tendency to vacuolization. × 860. (Army Institute of Pathology.)
FIG. 5. Same case. A section from the thymic rest found in the left side of the neck. Note the scattered lymphoid tissue and the prominent Hassall's corpuscles. × 315. (Army Institute of Pathology.)

addition received lactose and calcium lactate daily. Within three days the evidence of hypoparathyroidism disappeared and the previously mentioned measures were discontinued. Calcium and phosphorus determinations performed two days after operation revealed calcium, 11.2 mg., and phosphorus, 4.28 mg., indicating a definite change to normal values. Repeated Sulkowitch tests performed on the urine showed normal urinary excretion. Urinalyses postoperatively revealed essentially the same findings as the preoperative examinations. Three months after operation the calcium was 10.35 mg. per cent and the phosphorus 4.22 mg. per cent. Serial flat plate examinations of the abdomen after operation exhibited no further progression in the nephrocalcinosis. The symptoms of malaise, anorexia, constipation and polydipsia were all relieved following operation and the low back discomfort was improved.

CASE II. This twenty-six year old soldier was admitted to Walter Reed General Hospital on January 18, 1948. The patient's past history revealed that he had received treatment for malaria and hookworm disease. During the two years prior to admission the patient had suffered several attacks of kidney stones, and one year before admission an attack resulted in a right nephrostomy for removal of stones. Following this procedure the patient noted the passage of gravel in the urine upon several occasions. Blood chemistry studies performed at an overseas hospital one month before transfer to Walter Reed gave the following values: calcium 12.5 mg., phosphorus 2.7 mg. and alkaline phosphatase 5.9 mg.

Physical examination upon admission to Walter Reed was essentially normal. The patient was placed on a diet of approximately 124 mg. of calcium each day for a total of three days and twenty-four-hour samples of urine were collected. A very definite increased urinary excretion of calcium and phosphorus was found, an average value of 229 mg. per twenty-four-hour specimen for calcium and 937 mg. per twenty-four hour specimen for phosphorus. Serum calcium-phosphorus determinations gave the following results: calcium ranged from 13.7 mg. to 15.2 mg., phosphorus ranged from 2.8 mg. to 3 mg. Complete blood count and clotting and bleeding times were within normal limits as was the total serum protein and albumin-globulin ratio. The alkaline phosphatase was 6.04 Bodansky units with a normal of 2 to 9. Renal function studies including phenolsulfonphthalein, concentration and dilution tests and determination of the non-protein nitrogen in the blood were within normal limits. Both the excretory and retrograde urograms were normal.

On April 2, 1948, the patient was operated upon at which time a thyroidectomy type of incision was employed with division of the prethyroid muscles affording exposure of the entire thyroid. An ovoid, lobulated mass measuring 2 by 1.5 cm. was found just beneath the branching of the right inferior thyroid artery. (Fig. 6.) The right recurrent laryngeal nerve was visualized as it lay dorsomedially in relation to the tumor. The mass was entirely distinct from the thyroid gland itself although attached to the latter by areolar tissue. The tumor mass was

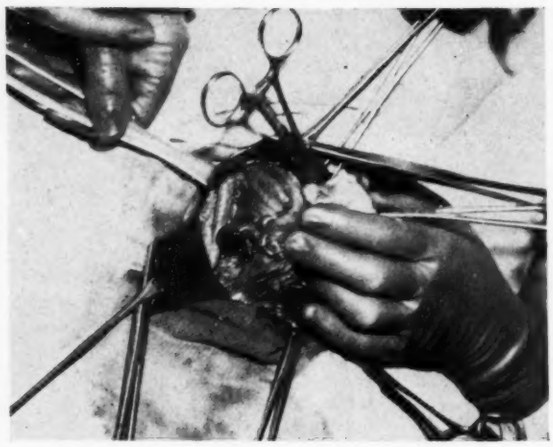


FIG. 6. Case II. Photograph at operation: the right lobe of the thyroid gland is retracted medially by the assistant's left hand. The inferior thyroid artery and middle thyroid vein have been divided. The parathyroid adenoma, with one border resting on the common carotid artery and the other border attached to the thyroid gland, may be visualized at the point of division of the inferior thyroid artery and middle thyroid vein.

released from its position beneath the inferior thyroid artery after the latter had been divided. The remaining parathyroid glands were normal. The mass was removed in its entirety and the wound closed in the usual manner.

The pathologic report was as follows: Grossly (Fig. 7), the specimen consisted of a single, yellowish tan, well encapsulated mass which measured 2.2 by 1.6 by 1.5. It was well encapsulated and on section had a homogeneous, yellowish tan appearance and a moderately soft consistency. Microscopically, sections of the tissue revealed the arrangement of cells into small cords and acinar-like structures with one type or the other predominating and with a small zone in which they integrated. The cells were primarily of two types. The larger cells had abundant, eosinophilic cytoplasm and small, round, basophilic nuclei. The smaller cells had a clear, vesicular, vacuolated cytoplasm and a similar small, basophilic, round nucleus. The stroma was sparse and vascular. Diagnosis was parathyroid adenoma.

Blood chemistry studies were as follows: April 2, 1948, after operation, calcium 11.6 mg. per cent, phosphorus 2.7 mg. per cent; April 3, 1948, calcium 9.7 mg. per cent and phosphorus 2.1 mg. per cent; April 5, 1948, calcium 11.2 mg. per cent and phosphorus 3.1 mg. per cent. Other calcium-phosphorus determinations taken subsequently showed comparable values.

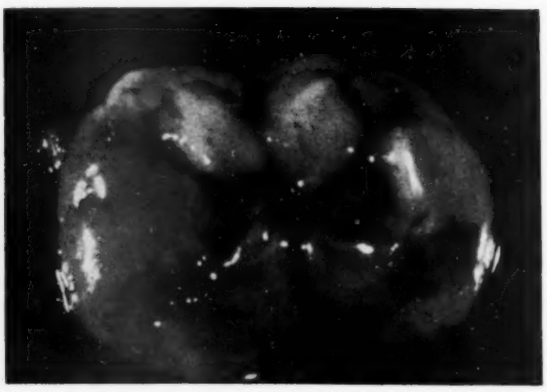


FIG. 7. Case II. A view of the parathyroid adenoma showing the lobulated character.

The patient's postoperative course was essentially normal; there was no evidence of hypoparathyroidism in the postoperative period. Renal studies performed two weeks after operation including serial urinalyses, flat plate of abdomen and intravenous pyelogram were normal. A repeat urinary calcium excretion test performed May 20, 1948, showed normal values. The patient was discharged to active duty.

SUMMARY

1. Embryologic and anatomic features of the parathyroid gland are discussed and the pathologic physiology of hyperparathyroidism is reviewed.

2. Early recognition of hyperparathyroidism is essential if serious renal and skeletal complications are to be prevented. As the disease remains unrecognized, renal insufficiency progresses and may become irreversible. All cases of renal lithiasis should be studied with the possibility of hyperparathyroidism in mind. A more widespread use of the Sulkowitch test is advocated.

3. The treatment of hyperparathyroidism is surgical. Removal of the hyperfunctioning parathyroid adenoma affords prompt correction of this abnormal state. Successful management depends upon close cooperation of the internist, pathologist and surgeon.

4. Two cases are presented illustrating features in the surgical management of parathyroid adenoma.

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EXPERIMENTAL THERAPY OF RAYNAUD'S AND BUERGER'S DISEASES WITH KUTAPRESSIN*

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STUDIES[1] of new therapeutic measures for thrombophlebitis have led us to the allied field of peripherovascular diseases, with emphasis on both Buerger's and Raynaud's diseases, for each of these clinical syndromes seem to have some points in common.[2]

Christian[3] defines Buerger's disease (thromboangitis obliterans) as a vascular disease involving arteries and veins with thrombosis, pain, intermittent claudication, edema, ulceration and gangrene. Vasospastic changes are common and probably most marked in the early stages. We owe the first complete study of the disease to Buerger. Christian[4] defines Raynaud's disease as a vascular change, chiefly seen in the extremities but occurring also in the internal parts, in which a persistent ischemia or a passive hyperemia leads to disturbance of function or to loss of vitality with necrosis.

Allen and Barker[5] state that some of the vasomotor disturbances of Buerger's disease can simulate Raynaud's disease. These authors say that there may be a frequent (30 per cent) association of vasomotor disturbances in organic arterial disease. In such cases the vasomotor disturbances of the Raynaud type dominate the clinical picture and the organic nature of the disease may be overlooked. The obliterative process is evidenced by signs and symptoms of impaired arterial blood supply. Superficial phlebitis is common.

What, then, are the differentiating symptoms and signs of Buerger's disease and Raynaud's disease? A differential diagnosis should be made so that more effective therapy can be rendered in each case. Furthermore, no new medication can be evaluated adequately for these two diseases unless an adequate differentiation is effected clinically. In order to summarize the differences between these two diseases the following diagnostic points are appended in Table 1:

TABLE 1

Diagnostic Factors	Buerger's Disease	Raynaud's Disease
Age	Between 25 and 40 yr.	Between 17 and 35 yr.[6]
Pulsation of arteries	50% pulseless 45% diminished 5% normal	Normal and pulsating
History	Intermittent claudication often present	Temperature changes produce cyanosis,[7] pallor, erythema with no intermittent claudication
Distribution of gangrene	Usually bilateral	Symmetrical
Degree of pain	Severe	Moderate
Excessive rubor with dependency and excessive pallor with elevation	Present	Absent
Rest pain	Usually severe	Absent
Exposure to cold and color changes	30%	Always present
Presence of edema	Frequent	Absent
Constancy of pain	Mostly constant	Paroxysmal[8]
Ulceration and gangrene, if present	Whole toe or deep	Limited to skin or superficial[9]
Associations	Arteriosclerosis, tobacco, syphilis	General vasomotor disturbances[10]
Emotional bouts effect severity	Absent	Present[11]

Yater[12] states that a patient with Buerger's disease is apt to be an invalid about 50 per cent of the time. Rest in bed is needed during the active phases of the disease. Other methods used include heat cradle, Buerger's exercises and/or pavaex machine, intravenous injection of typhoid vaccine, oscillating (Sanders) bed, injections of hypertonic saline solution, use of small doses of whiskey, use of mecholyl or mecholine, ganglionectomy or ramisectomy (various operations), morphine if necessary for pain and barbiturates.

The current therapy for Raynaud's disease includes the following: place patient in warm climate, contrast baths, morphine for pain control, galvanism, nitroglycerin, sodium lactate, thyroid extract, anterior lobe pituitary gland substance, various sympathectomies, various ganglionectomies, injections of foreign protein,

* Manufactured by the Kremers-Urban Co., Milwaukee, Wis.

estrogenic hormonal substances, psychiatric therapy (avoid emotional stress) and pavaex machine.

Surgical measures are used for the treatment of both diseases when medical therapy does not produce adequate results. At best, surgery is a costly method and it hospitalizes such patients for a protracted period of time. Furthermore, results obtained by this means are not always lasting even if improvement takes place temporarily.

THEORY OF KUTAPRESSIN THERAPY

Kutapressin is derived from fractionated liver paste or extract. This material seems to possess the ability to shrink, at least partially, keloids and papillomas.[13] This interesting action is thought to be the result of the medication's effect on the arterioles of the integument so that a vasoconstriction takes place, thus assisting the blood and tissue circulation in the affected skin when chronic passive congestion is omnipresent. This vasoconstriction has reversed the already reversed albumin-globulin ratio in a patient who suffered from extensive keloid formation.[14] Hence the edematous state was relieved and this release of further pressure upon the integument caused a marked decrease in the size of the patient's keloids. This observation was recorded previously many times[15] by the author in other patients.

This unique pharmacologic action with kutapressin has been observed in several skin conditions, namely, acne vulgaris, acne rosacea, rhinophyma and pruritus ani. Many times the latter condition is caused by a vasomotor upset. The intense itching which accompanies this disease is ameliorated rather quickly with the use of kutapressin,[16] which is administered subcutaneously.

In spite of the apparent vasoconstriction of these diseased skin areas, we have never been able to demonstrate a rise in systemic blood pressure following the use of this material in humans. Orth[17] verified this lack of increase in blood pressure in dogs following the injection of kutapressin.

With the preceding observations, along with others, we thought this material warranted a trial in other vascular diseases because the material was practically painless upon injection and it was found to be practically non-toxic. If it did not bring about clinical improvement, it certainly would do no harm.

CASE REPORTS

Our first series of observations as to the efficacy of this material in Buerger's disease arose quite by chance. J. O'C., a thirty-two year old white male, consulted us because of the presence of dilated veins on the sides of his face. He mentioned that he had been treated intensively for Buerger's disease; but since we were interested mainly in shrinking the size of these facial veins, not much attention was paid to his thromboangitis obliterans. He was given injections of kutapressin subcutaneously in 1 cc. doses daily for several weeks. Within this time a marked improvement was noted in the diminution in the size of the facial veins. He called our attention to the fact that his intermittent claudication, which had been most bothersome upon walking, had improved markedly. Whereupon, we immediately diverted our attention from his improved facial veins to his peripheral vascular disease. This patient had submitted to a sympathectomy at a veteran's hospital in 1946 while in the armed service and another sympathectomy on the opposite side in a veteran's hospital in Wisconsin in 1948. Both operations were lumbar sympathectomies. Following these surgical procedures the patient could only walk one block without intermittent claudication. He was given 1½ ounces of whiskey three times daily in order to control the pain prior to the time he consulted us.

He has been under our care for over a year. He has been receiving 1 cc of kutapressin twice a week for many months. In this period of time he has had no pain in his legs. When he walks more than eight blocks, he reports a tired feeling and heaviness in his legs. He has not had any pain that he can recall. There are now pulsations in both dorsal pedis arteries.

Mrs. R. La F., age thirty-five, has been diagnosed as having Raynaud's disease for a matter of three years. She experienced pain in both hands accompanied with extreme pallor. These attacks were present spasmodically and would last around half an hour. Many times she stated that she would be free of an attack only to experience another. She has been extremely nervous and she related that cold weather made the attacks both more severe and frequent. She has been receiving 1 cc. of kutapressin subcu-

taneously twice a week for a period of about nine months.

At one time she was out of the city and without this treatment for a period of two weeks. During that time her attacks became much more frequent and severe. Upon her return and subsequent injections her hands became relatively free of any attacks of vasospasm in spite of the fact that she hung her laundry out-of-doors in freezing weather. Prior to kutapressin therapy she could not tolerate cold weather and had to remain indoors with her hands on a heating pad.

We have been able to collect another case of each type of disease (Buerger's and Raynaud's diseases). Our findings with these patients are very similar to the aforementioned cases. Consequently, we will avoid repetition and merely state that the therapeutic results appear promising with the use of kutapressin in these cases.

It is rare to find these diseases in the general practice of medicine. When such patients are diagnosed, they are usually sent to a vascular disease center for therapy. Therefore, the general practitioner rarely discovers such a case.

These findings are presented with the hope that our surgical colleagues may try our therapeutic suggestions on their own cases. By such means a better evaluation of these therapeutic suggestions may be effected for these two syndromes which have caused so much pain and suffering in their victims.

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A SAFE METHOD OF PANCREATIC BIOPSY*

A PRELIMINARY REPORT

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TODAY the principal difficulty in dealing with surgical lesions of the pancreas is the establishment of the diagnosis. The magnitude of this problem is well documented in the literature. Hartman, Cattell and Pyrtek[5] and Carlson reported that benign lesions in the pancreaticoduodenal region causing confusion with carcinoma on gross examination range from 10 to 19 per cent. Child believed that the diagnosis of pancreaticoduodenal carcinoma at operation is one of the most difficult and serious problems with which a surgeon may be faced. Orr pointed out the difficulty in distinguishing common duct stone, chronic pancreatitis, benign adenoma and malignant tumor. He agreed with Kiefer and Moravec that lesions are designated inoperable carcinoma at the operating table only to have the patient live in good health for many years. Cattell[3] stated that considerable difficulty may arise in proving pancreaticoduodenal carcinoma at operation and added that this is in part due to the irregular extensions and divisions of the pancreas which on palpation may be confused with tumor.

The status of diagnosis in pancreaticoduodenal lesions and the need for more accurate diagnosis are well put by Child who said, "At the present time there is no adequate method by which a patient with such a tumor can always be assured of a positive diagnosis of carcinoma prior to a radical pancreaticoduodenal resection. If a positive diagnosis is to be insisted upon, a certain number of patients will be deprived of an opportunity of cure: if gross surgical pathology is to be relied upon in early phases of carcinoma of the pancreas, it is certain that a number of patients will be subjected to needless hazards."

REPORTED MISTAKEN DIAGNOSES

Probstein et al. pointed out that exact diagnosis was not so important when the operation for relief of obstruction of the biliary tract secondary to a mass in the head of the pancreas was the same (cholecystoenterostomy) regardless of the type of lesion. Since the work of Whipple and others, however, has offered hope of cure of malignant lesions in this region by way of radical pancreaticoduodenal resection, the seriousness of mistakes in diagnosis is great. Hunt reported a case in which a mass in the head of the pancreas was interpreted as chronic pancreatitis at cholecystectomy for cholelithiasis. Rather prompt obstruction of the common bile duct after operation and persistent external biliary fistula led to reoperation, at which time a diagnosis of carcinoma of the head of the pancreas was made and successful radical pancreaticoduodenal resection performed. Undoubtedly, there are a considerable number of cases of obstructive jaundice caused by pancreaticoduodenal carcinoma which are interpreted as chronic pancreatitis by the surgeon who performs a biliary diversion (cholecystoenterostomy) as a final procedure. This type of case is not likely to be reported. Child reported that four of a group of eleven patients without clearly defined disease of the biliary tract and diagnosed as chronic pancreatitis at operation at the New York Hospital died within two years, presumably of carcinoma of the pancreas. He also reported three cases of carcinoma of the head of the pancreas in which cholecystectomy had previously been performed for their disease. Cole and Reynolds, Maingot and Phillips reported four such cases.

On the other hand, Carlson, Cattell,[3,5] Child, Hartman, Hunt, Kiefer, Orr, Probstein, Warren, and Walters and Dehne reported seventy-seven cases in which carcinoma of the head of the pancreas was diagnosed at operation and later the tumors were proved to be benign. At least nine of these patients were subjected to radical pancreaticoduodenal resection, with a considerable mortality.

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PRESENT METHODS OF DIAGNOSIS

Methods of determining the diagnosis of extrahepatic lesions causing obstructive jaundice have been outlined by Child, Cattell, Orr and others. Child divided these lesions into five groups.

The first was primary carcinoma of the extrahepatic bile ducts. Those amenable to surgical excision are confined to the lower two-thirds of the common bile duct. This is a relatively rare group of tumors which are easily diagnosed by retrograde exploratory operation through the ampulla of Vater or, when necessary, by choledochotomy.

The second was primary carcinoma of the duodenum. These tumors are readily diagnosed by palpation and by biopsy.

The third group was benign tumors of the ampulla. These lesions are rare and often inflammatory. All should be considered malignant unless proved beyond all question to be benign.

The fourth group was malignant tumors of the ampulla. These tumors are usually small and likely to escape detection unless they are kept in mind. Diagnosis is made by palpation against the head of the pancreas through the wall of the duodenum and by duodenotomy with biopsy.

The fifth group was carcinoma of the pancreas. This tumor is the most frequent lesion in this region. If there is no evidence of metastases or extension indicating inoperability, if gallstones have been excluded, when necessary by retrograde exploration; and if there is no intrinsic tumor of the biliary tree, duodenum or ampulla and the only positive finding is a mass in the head of the pancreas, diagnosis is usually dependent upon either conventional biopsy with frozen or permanent section or the operators' diagnosis of the gross findings. Cattell[4] pointed out that palpation of small tumors in the head of the pancreas is facilitated by elevation of the duodenum and the head of the pancreas and that in very early lesions arising in one of the main ducts in the head of the pancreas the only indication may be dilatation of the duct of Wirsung. He stressed that in the absence of a positive histologic diagnosis resection should not be done unless dilatation of either the pancreatic ducts or biliary tracts can be demonstrated. It should be remembered that the differential diagnosis between carcinoma and chronic pancreatitis may be difficult not only on gross examination but also on microscopic frozen section of a conventional biopsy specimen.

LIMITATIONS OF CONVENTIONAL BIOPSY

In most sites in the body difficulties in diagnosis are satisfactorily resolved by recourse to biopsy and either frozen or permanent section. Once again the literature yields ample evidence that conventional biopsy has numerous limitations in pancreatic lesions. Chiefly, these are hemorrhage, formation of fistula and inability to obtain representative tissue. The last of these is due to the fact that the neoplasm in resectable cases usually lies deep in the organ, surrounded by chronic pancreatitis which is often similar in gross appearance and consistency to carcinoma. Thus the choice of biopsy site is difficult and a true biopsy would be too mutilating to be practical.

Walters believed that the risk of biopsy of the pancreas in these deeply jaundiced patients was not warranted. That this view is widely held is shown by Probstein who cited the 1,035 operative cases of pancreatic masses reported by Frazer in which only an exceptional biopsy specimen was taken. He pointed out that even with the advent of vitamin K and such hemostatic agents as gelfoam® there has been no appreciable increase in the number of biopsies. In his own series there were twenty-eight biopsies of masses in the head of the pancreas over a ten-year period in a group of approximately 400 carcinomas of the pancreas. Child reported twenty-five biopsies in ninety-seven patients operated upon for a mass in the head of the pancreas.

After reviewing the literature regarding the diagnosis of tumors in the head of the pancreas at the time of operation, Carlson concluded that conventional biopsy is unsatisfactory and often unsafe. He pointed out that the frequent association of chronic pancreatitis with carcinoma often results in the malignant tissue not being included in the section. Cattell[2] concurred that conventional biopsy is unsatisfactory and unreliable.

The undependability of conventional biopsy is further shown by Probstein's report of eighteen biopsies reported as non-malignant, at least eleven of which subsequently proved to be carcinoma. Child related that in a series of twenty-five patients with carcinoma of the

FIG. 1. Vim-Silverman needle biopsy specimen of adenocarcinoma of the pancreas. × 50. This case is not described in the text but this photomicrograph is included because of the clarity of its microscopic pathologic condition.

head of the pancreas over 90 per cent of whom had far advanced carcinomas, positive biopsy report was obtained in only 60 per cent.

A PROPOSED METHOD OF BIOPSY

Since its first description in 1946 there has been wide acceptance of the Vim-Silverman needle as a proven method of biopsy. Its use in liver biopsy was discussed in a recent editorial by Hoffbauer.[10] It is often used for preoperative biopsy of suspected carcinoma of the breast in the poor risk patient in whom a minimum of operative time is desired. Of course, with a single biopsy only a positive one is of significance. It has probably been most widely used at the New York Memorial Hospital for Cancer and Allied Diseases.

The use of the Vim-Silverman needle at laparotomy is a method of obtaining a pancreatic biopsy specimen which overcomes the deficiencies and dangers of conventional biopsy. The method can also aid in determining the operability of pancreaticoduodenal neoplasms as it is ideal for the biopsy of questionable metastases deep in the substance of the liver (Case 11). With the increasing agressiveness in the treatment of benign lesions of the pancreas and with our lack of knowledge of some stages of these lesions, the application of this method of biopsy to benign lesions of the pancreas may offer even greater possibilities.

With the Vim-Silverman needle a specimen, 16 mm. long and 1 mm. in diameter, from a tumor at any depth can be obtained at time of laparotomy. Although a specimen of this size

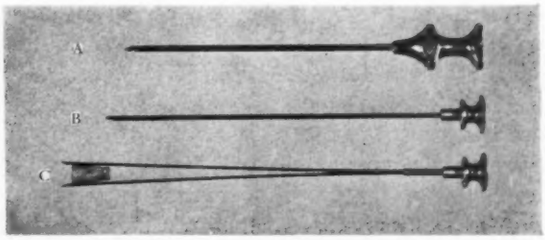

FIG. 2. The 3⅜ inch Vim-Silverman biopsy needle; A, the outer cannula; B, the obturator for the cannula and C, the inner needle with its biopsy blades.

does present certain limitations as compared to a larger specimen, a pathologic diagnosis is usually readily made. (Fig. 1.) A specimen of appreciable size is rarely obtained from the pancreas by any method except resection and this drawback may be compensated for by taking several biopsy specimens from various areas of the tumor. The specimen is not particularly suited to frozen section technic.

The dangers of biopsy of the pancreas with the Vim-Silverman needle are not great for if the wall of a major vessel or duct is entered it usually closes on withdrawal of the needle and the surrounding pancreas helps to seal off the defect. If oozing is a problem, it is readily controlled with a small piece of gelfoam® and pressure.

The Vim-Silverman needle consists of three parts: the outer cannula which is 14 gauge and comes in both 2⅜ inch and 3⅜ inch lengths; the obturator for the cannula and the inner needle which is 17 gauge and 9/16 inch longer than the outer cannula. It is split longitudinally into two blades. (Fig. 2.)

TECHNIC

The technic of biopsy of the pancreas with the Vim-Silverman needle is as follows: At laparotomy the pancreas is outlined on the posterior abdominal wall by entering the lesser sac through an incision in the gastrocolic omentum or the gastrohepatic ligament. The peritoneum overlying the pancreas is not incised. The outer cannula with its obturator is introduced into the area of pancreas from which a biopsy specimen is desired. In the case of neoplasm the needle is introduced until the increased resistance usually accompanying carcinoma is encountered. The outer cannula is then steadied to prevent further advance, the obturator is removed and replaced with the inner biopsy needle which is passed to its hilt. The inner biopsy needle is then steadied to

prevent its further advance and the outer cannula is advanced over it for a distance of ½ inch and rotated through 360 degrees. The two needles are then withdrawn simultaneously and the plug of tissue between the blades of the inner needle is placed on filter paper and then in preservative, such as formalin or Zenker's solution. Sections are prepared in the usual manner.

APPLICATION OF METHOD

A reasonable approach to the treatment of a mass in the head of the pancreas would seem to be exploration with careful search for regional and distant metastases or direct extensions of carcinoma; exclusion of ampullary, duodenal or common duct carcinoma by palpation, transduodenal exploration and biopsy; search for common duct stones by retrograde exploration and examination for dilatation of duct of Wirsung; if these are all negative at least three biopsy specimens should be taken from different areas of the mass with the Vim-Silverman needle and a first stage procedure for diversion of the biliary tract (cholecystoenterostomy) performed. If the biopsy specimens are positive on permanent section, the second stage can be done with confidence in the usual manner. If the biopsy specimens are negative, the second operation should be approached with the knowledge that there is a good chance that the lesion is benign. With the limited experience with this method of biopsy one must still rely on the operative and clinical findings in order to make the decision for or against pancreaticoduodenal resection. At times it will be necessary to do a resection in the absence of a positive biopsy. The most important clinical finding is a demonstrable dilatation of the pancreatic duct as described by Cattell.

CASE REPORTS

CASE I. A man, seventy-one years old, had had painless jaundice for five weeks. A clinical diagnosis of carcinoma of the head of the pancreas was made. This diagnosis was thought to be confirmed at laparotomy by the finding of a dilated biliary tract and a surgically removable hard, irregular mass, 3 cm. in diameter, in the head of the pancreas. Cholecystojejunostomy was performed as the first stage of a contemplated pancreaticoduodenal resection. No biopsy specimen was taken. Postoperatively, he improved rapidly. He refused further surgery. During the next three and one-half months he led an active life, was asymptomatic and gained 8 pounds in weight. At the end of this period he had an attack of cholangitis which was followed during the next five months by increasingly severe symptoms. At first he experienced only nocturnal pain in the upper part of the abdomen and extending to the back but gradually the pain became constant and was associated with anorexia and subsequent weight loss.

Because of the patient's relatively good general condition and moderate symptoms it was thought by members of the surgical staff that the possibility of chronic pancreatitis rather than carcinoma must be considered in this patient. Therefore, nine months after his first operation a second surgical procedure was performed. It was planned to interrupt the autonomic nerve supply if a benign lesion were present. At operation there was massive extension of the tumor locally and to the regional lymph nodes. Biopsy confirmed the diagnosis of adenocarcinoma of the pancreas. His condition subsequently deteriorated, with increasing pain, pancreatic deficiency and increasing duodenal obstruction. He died fourteen and one-half months after the first operation.

In this case a Vim-Silverman needle biopsy would have been useful. If a positive biopsy specimen had been obtained by such a method, the need for a second stage operation might have been more effectively presented. If this advice had been refused, the patient would not have undergone his second operation at a time when the symptoms indicated inoperability in the presence of proven carcinoma.

CASE II. When first seen by members of the gastrointestinal service this forty-nine year old white man had had increasingly severe and frequent epigastric pain of two months' duration. The pain extended to his back and he vomited occasionally.

Repeated roentgenograms of the upper gastrointestinal tract showed only pylorospasm. Gastroscopic examination revealed superficial gastritis. The pain was somewhat relieved by administration of atropine but not by other medications. On physical examination the stooping posture suggested epigastric discomfort and moderate epigastric tenderness. There were no palpable abdominal masses. During the next six months there was weight

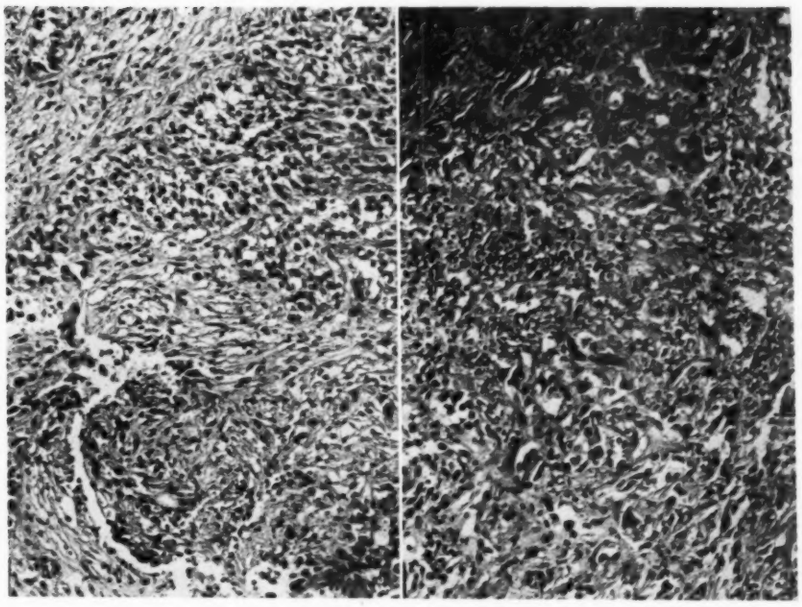

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FIG. 3. Case II. Vim-Silverman needle biopsy specimen of anaplastic adenocarcinoma of the pancreas. × 125.

FIG. 4. Vim-Silverman needle biopsy specimen of a deep-seated liver metastasis. Same case as shown in Figure 3. × 125.

loss of 45 pounds and gradual increase of symptoms. Laboratory tests, including pancreatic and liver function tests, gave essentially negative results. There was no occult blood in the stool.

Eight months after the onset of symptoms the patient was referred to the surgical service for consideration of exploratory laparotomy. In view of his increasing symptoms without localizing signs, this was carried out. At operation the entire pancreas except for the tail was hard and indurated. In the central portion there was a hard, lobulated mass, 10 cm. in diameter. There was no evidence of biliary tract obstruction. Hard, fusiform masses were present deep in the substance of the liver which were thought to be metastases. Biopsy specimens using the Vim-Silverman needle were taken of the pancreatic and liver masses. Both (Figs. 3 and 4) showed adenocarcinoma.

Following operation the patient's condition deteriorated. The pain was temporarily alleviated but when he was last seen four months after operation he had almost constant pain, pancreatic insufficiency, ascites and a hard rectal shelf.

In retrospect it is obvious that this patient should have come to operation earlier. He is presented to illustrate the effectiveness of Vim-Silverman needle biopsy of pancreatic tumors and deeply placed liver metastases.

CASE III. This severely ill and somewhat confused eighty year old white man was admitted to the surgical service. For two days he had had abdominal pain, severe and crampy at first, then becoming constant and localized to the upper part of the abdomen and accompanied with vomiting. The past history revealed intolerance to fatty foods and many episodes of vague abdominal discomfort.

Except for dehydration, the significant physical findings were confined to the abdomen which was slightly distended, with hyperactive peristalsis and marked upper abdominal tenderness, rebound tenderness and muscle spasm. Vital signs were normal and examination of the blood gave negative results except for leukocytosis of 19,000. The serum amylase value was 64 units which represents the upper limits of normal with the test used. A tentative diagnosis of acute pancreatitis was made but acute cholecystitis could not be ruled out. By the next day there was increased tenderness in the right upper quadrant of the abdomen. Both the serum amylase and urinary diastase were 48 units and the leukocytosis and toxicity persisted. Impending rupture of the gallbladder could not be ruled out; therefore, exploratory

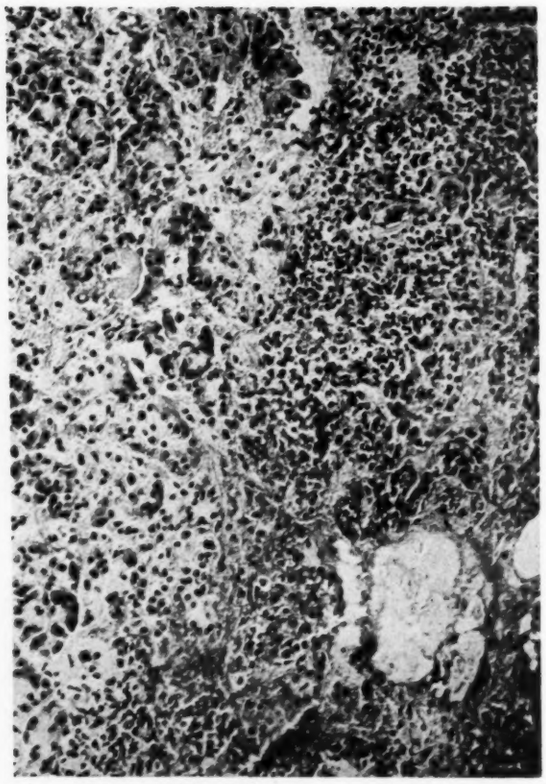

FIG. 5. Case III. Vim-Silverman needle biopsy specimen of acute hemorrhagic pancreatitis. × 125.

operation was carried out. The gallbladder was surrounded by adhesions, thick-walled and filled with small stones. It was not inflamed. There was a considerable amount of slightly cloudy, brownish fluid in the abdomen (amylase 1,024 units). The entire pancreas was hemorrhagic, with spotty areas of necrosis throughout and scattered areas of fat digestion and calcium soap formation. A Vim-Silverman needle biopsy of the head of the pancreas (Fig. 5) showed extensive necrosis and inflammation of the pancreas. The abdomen was drained and closed.

The afternoon of operation the serum amylase level rose to over 1,000 units and urinary diastase to 256 units. By the second postoperative day these had both returned to normal. The postoperative course was uneventful but slow. By the eighth postoperative day abdominal drainage had ceased. There was no glycosuria. He was discharged on the twenty-second postoperative day. When last seen ten months later he was asymptomatic.

Vim-Silverman needle biopsy in this type of case in which inadvertent operation is performed, plus biopsy of other non-malignant conditions and tumors of the pancreas, will gradually add to our knowledge of these conditions.

SUMMARY

It is often difficult at operation to distinguish between a benign and a resectable malignant mass in the head of the pancreas.

Mistakes of diagnosis are made in both directions, as is amply shown by a review of the literature. Correct diagnosis is of great importance if patients with early malignant disease are to be cured and if patients with benign lesions are to be saved unnecessary resections.

Conventional biopsy is not routinely done because of the dangers of hemorrhage or fistula formation and because the biopsy specimen cannot be relied upon for a correct diagnosis.

The Vim-Silverman needle appears to offer a safe and reliable method of biopsy of the pancreas or of the liver. Further experience with this method of biopsy is necessary for its final evaluation.

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According to P. G. Raspall calculi in the urinary bladder, when primary, consist of oxalates or urates. Phosphatic stones occur secondarily, usually arising in the kidneys and finally passing into the bladder. (*Richard A. Leonardo, M.D.*)

BILIARY TRACT SURGERY

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TWO important facts have resulted from experimental and clinical observation of biliary tract disease. Gatch[1] and others[2–4] have emphasized through experimental studies that cholecystitis is nearly always the result of mechanical obstruction which in turn is due to alterations in the chemistry of the bile or disturbances of biliary function. Infection then takes over to dominate the picture but is not usually the primary cause. In a series of 109 consecutive personal cases (U. M.) it was demonstrated that, clinically, biliary tract disease is rarely a dire emergency. There are two general exceptions to this clinical consideration, namely, an empyema of the gallbladder with acute manifestations or perforation. Gangrene of the gallbladder, in varying degrees of severity, is a rare third cause which should not go unmentioned. This condition is not uncommonly seen preceding perforation. If the previously mentioned experimental and clinical facts are acceptable to the reader, we may establish some criteria for proper therapeusis through the medium of this discussion.

Many surgeons advocate early operation in biliary tract disease. Upon careful analysis of their conclusions, however, it is noted that a time element for adequate preparation of the patient is always mentioned. In this regard it is unfortunate that an analogy has been drawn between the acute appendix and acute gallbladder. It is well to keep in mind that the two diseases are primarily different in their etiology. Appendiceal disease is usually an acute bacterial inflammation. Biliary tract disease, on the other hand, is primarily the result of chemical changes with mechanical obstruction. Bacteria play a secondary role when the disease progresses. If the appendix is removed while the disease is intra-appendicular, an uneventful recovery may be expected. If the appendix is not removed at this stage, gangrene and perforation may ensue, these being the dreaded complications that produce high morbidity and mortality. The surgeon in treating biliary tract disorders, be they acute or chronic, must answer the following questions: (1) Does the case warrant surgical intervention? (2) If so, when is the proper time for surgery? (3) What is the operative procedure of choice? We shall attempt to analyze these questions based on the results of 109 cases covering the ten-year period from 1940 to 1950 at the Touro Infirmary of New Orleans.

The mortality rate in this series was 3.7 per cent, the four deaths occurring in patients fifty-six, sixty-nine, seventy-three and seventy-four years of age. These were cases of subhepatic and periduodenal abscess containing gallstones, empyema of the gallbladder, cholelithiasis with carcinoma of the liver and postoperative biliary fistula. The mortality rate in a series of this sort would vary according to the incidence of acute, chronic and neoplastic cases. Postoperative mortality for these conditions in the literature and in the country at large would be 5 to 20 per cent in the acute disease, less than 5 per cent in the chronic disease and 5 to 40 per cent in the neoplastic disease. It is well recognized that the mortality rate is much higher for patients over fifty years of age with biliary tract disease. In the acute disease it has been reported as high as 50 per cent. The average age of this group was forty-six years; 70 per cent were females. A diagnosis of cholelithiasis was made in 84 per cent of the cases; 15 per cent had acute cholecystitis. Cholecystectomy was performed in 78 per cent of the cases. In 9 per cent cholecystostomy was considered to be the safer procedure. In another 9 per cent the Martin-Gatch procedure was undertaken (i.e., entire removal or destruction of the entire gallbladder mucosa by cauterization or the electosurgical unit). Other types of procedures including choledochoduodenostomy, drainage of a periduodenal abscess, choledochocholedochostomy and cholecystostomy for removal of a stone with primary closure of the gallbladder wall were performed in the remaining 4 per cent.

OPERATIVE INTERVENTION

Operative intervention in biliary tract disease is indicated in the following: cholelithiasis,

extrahepatic biliary obstruction, hydrops of the gallbladder, empyema of the gallbladder and perforation of the gallbladder.

Presence of cholelithiasis is an absolute indication for surgery. Symptoms of this condition are usually classic although occasionally an atypical picture occurs. Roentgenographic studies may confirm the presence of gallstones. Stones containing sufficient calcium will visualize without the use of contrasting dye because of their radiopaque nature. Radiolucent stones, more difficult to detect, are best demonstrated by a contrast medium. In the current series a major portion of the patients with cholelithiasis showed x-ray proof of the presence of stones.

The non-calculus, functioning gallbladder is, of course, not a surgical problem. The gallbladder in which the dye fails to concentrate is a problem which may on occasion require surgical exploration. The x-ray diagnosis of a non-functioning gallbladder is occasionally due to the failure of a defective liver to excrete the dye. In other instances failure of the gallbladder to visualize may be due to inability to concentrate the dye or obstruction of the cystic duct. At least two attempts at cholecystograms at monthly intervals should precede any decision for surgery. There are those who believe that a non-functioning gallbladder is associated with progressive liver damage. While symptomatic relief in the removal of the non-functioning, non-calculus gallbladder is not entirely satisfactory, progressive liver damage is probably ameliorated and the defective gallbladder function corrected. The gallbladder may be found at surgery to be filled with stones. Removal of the organ effects a complete cure in these cases.

A second absolute indication for operative intervention is extrahepatic obstructive jaundice. The liver function tests as recommended by Snell[5] are an aid in making the diagnosis. At the Touro Infirmary a liver profile examination of the jaundiced patient consisted of the following: (1) serum bilirubin, (2) galactose tolerance, (3) alkaline phosphatase, (4) serum protein and A-G ratio, (5) prothrombin time, (6) thymol turbidity and (7) the cephalin flocculation test. Nadler[6] has stressed the value of the cephalin flocculation test for it serves as an index of defective liver function which in turn may be due to conditions other than biliary tract disease. In the early, uncomplicated, afebrile icteric patient an index of less than 3 plus indicates extrahepatic obstructive jaundice. If an index of 3 or 4 plus appears, the condition may be hepatitis or intrahepatic disease. The alkaline phosphatase determination in cases of obstructive jaundice usually reads above 5 Bodansky units.

Other indications for operative intervention in biliary tract disease are hydrops or empyema of the gallbladder and free perforation of the gallbladder.

Time for Operative Intervention. The only indications for emergency surgical intervention in extrahepatic biliary tract disease are empyema and perforation of the gallbladder. Other acute cases should be carefully observed, and in most instances the acute phase will subside. The patient should be maintained in the best possible systemic condition while awaiting interim surgery. Hasty surgery can be disastrous in this potentially dangerous area. Wherever possible, therefore, it is wiser to wait, employing symptomatic therapy until the acute episode subsides. Surgery will be better tolerated two to six weeks after the acute attack when the patient is in an improved systemic condition and the local edema and inflammation are less pronounced.

Tests are run promptly and if necessary daily on the jaundiced patient in order to speed diagnosis. If surgery is planned, indicated nutritive supplements are prescribed. When adequate clinical and laboratory studies have been conducted and a presumptive or conclusive diagnosis of extrahepatic obstruction has been arrived at, the surgeon may proceed knowing that his patient is well prepared and well studied.

Those patients with a right upper quadrant mass, presumably a distended gallbladder, are not always to be considered a surgical emergency. The patient with hydrops should be adequately prepared for surgery. Womach[7] suggests the use of sympathetic blocks of the right celiac ganglia or lower thoracic sympathetics as an aid to abatement of the condition. If this method proves effective in allowing drainage, it is safe to postpone surgery for several days until the patient is in optimum condition.

Febrile patients with a tender right upper quadrant mass are closely followed up. Interval blood counts are taken every six to twelve hours as necessary and the temperature and clinical course are carefully watched. Wherever possible a conservative therapeutic course of

antibiotics, antispasmotics, analgesics and parenteral therapy is followed. When there is failure to respond or progression of the condition, early cholecystostomy is indicated. Rarely can a cholecystectomy, the desideratum, be safely accomplished.

Free perforation of the gallbladder is rare since this organ is well walled off by neighboring structures and the omentum. In a condition of this type, however, an acute surgical abdomen is present and immediate surgery is imperative. No cases of free perforation of the gallbladder were encountered in this series.

It should be emphasized, therefore, that emergency surgery of the extrahepatic system is, fortunately for the safety of the patient and for the nerves of the surgeon, an unusual situation. Conservatism followed with interim surgery at a period when the patient is in optimum condition locally and systemically is the method elected in this series of cases.

Preferred Procedure. The operative procedure of choice in cholelithiasis is cholecystectomy. Identification of the cystic duct, common duct and cystic artery is necessary during the removal of the gallbladder. In this series of cases, besides this dissection, the common duct and the pancreas were well palpated. The common duct is best explored with the right hand from the patient's left side. If the surgeon is on the patient's right, he turns his back partially to the operating table while twisting his right arm to feel the duct. The index finger is placed in the foramen of Winslow and the thumb above so that the common duct can be moved about. In this manner stones can often be palpated, if present. The normal pancreas when explored by hand presents definite lobulations much like the individual grains on an ear of corn. If there is evidence to suggest pancreatitis or chronic liver disease, it may be wise to perform a simple cholecystostomy, this decompressive procedure allowing external drainage. Cholecystenterostomy may be chosen as an alternate procedure.

In the presence of choledocholithiasis exploration of the common duct by probe, scoop and forceps is performed. Choledocholithiasis should be suspected if the patient gives a history of jaundice or clay-colored stools, if at surgery the common duct is dilated or thickened or if by palpation of the common duct a suspicious area is detected within the lumen. After the common, right and left hepatic ducts are thoroughly explored, a T tube is inserted. The tube is always beveled at the ends and a wedge-shaped area cut from the center to facilitate removal. Only 5 per cent of the patients in this series required exploration of the common duct.

When the acute disease is present at operation (i.e., acute cholecystitis, empyema, hydrops or perforation of the gallbladder), the simplest technical procedure is generally necessary due to the poor condition of the patient. If the patient's condition allows and it is technically possible, cholecystectomy may be performed. In most cases, however, cholecystostomy with drainage or removal of stones and debris from the gallbladder is all that is indicated. This decompressive procedure will best tide the patient over the acute episode and, if required, cholecystectomy may be undertaken at a later date. In some cases, after drainage of the gallbladder, this organ will shrink, atrophy and give no further trouble.

The Martin-Gatch procedure is often most valuable when the patient's condition mitigates against an extensive procedure in the presence of anatomic or technical difficulties or if there is a particular desire to be conservative. The technic of this procedure entails excision of as much of the mucosa of the gallbladder as possible, cauterization of the remaining mucosa and insertion of a Pezzer catheter, tied securely with a purse-string suture, which is allowed to drain to the outside. This procedure will in most cases result in a non-functioning gallbladder upon removal of the catheter. In the current series this method was used as often as cholecystostomy and with equally gratifying results.

The cause of extrahepatic biliary obstruction, other than stones, will depend upon the nature of the obstruction. Tumen's[8] classification of the nature of the obstruction is a good one. He divides the group into intraluminary, interluminary and extraluminary. In carcinoma of the pancreas, the most common extraluminary disease, indications should be met. In instances of stricture or division of the common duct an end-to-end choledochocholedochostomy is performed. One such repair in this series (reported earlier by Maes[9]) was performed over a rubber tube. Another case in this series, referred by another physician, included simple drainage of a right upper quadrant abscess that had developed four months after cholecystectomy

for cholelithiasis. In another patient an unsuspected neoplasia of the liver led to the simple removal of a gallstone for purely symptomatic relief and closure of the gallbladder wall with no additional surgery warranted. In order to close a postoperative biliary fistula, one patient in this series had a choledochoduodenostomy.

SUMMARY

1. Experience with 109 consecutive cases of biliary tract disease over a ten-year period from 1940 to 1950 demonstrates that no absolute rule can be applied in any series of cases. A guide to therapy is offered through the posing of three questions regarding the warranty of surgical intervention, proper time for surgery and operative procedure of choice.

2. Indications for surgery, other factors permitting, are as follows: cholelithiasis, extrahepatic biliary obstruction, hydrops, empyema and perforation of the gallbladder. Establishing these diagnoses is the major problem.

3. Empyema with acute manifestations or perforation of the gallbladder are the only conditions in which emergency surgery is indicated in extrahepatic biliary disease. Conservative therapy is preferred in all other cases until the patient has been nutritionally and medicinally prepared to withstand surgery in so potentially hazardous an area.

4. The procedure of choice cannot be determined beforehand. It is dependent upon findings at the operating table at which time the patient's general condition, disease process and prognosis are all considered prior to the selection of the type of operation.

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EFFECT OF GELFOAM® ON THE INTEGRITY OF INTESTINAL ANASTOMOSIS*

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THE use of absorbable hemostatic agents in a contaminated field is attended with increased risk of infection. Cipolla and Narat[1] demonstrated the greater intensity of bacterial infection which occurred when these absorbable materials were added to an infected field. Laufman and Method[2] showed deleterious effect of placing gelatin sponge in contact with anastomoses of the large intestine. They believed the increased incidence of perforation and peritonitis was due to the fact that gelfoam® acted as an excellent culture medium for the contaminating bacteria.

If gelfoam® is to be of distinct advantage as a hemostatic agent in the contaminated peritoneal cavity, we must remove the danger of intensification of infection.

Jenkins, and Correll and Wise[3,4] had proposed using gelatin sponges impregnated with antibiotics for application to infected wounds. By the work of Rothenberg et al,[5] the superiority of massive doses of penicillin, both intraperitoneally and systemically, to chemotherapeutic and other antibiotic agents has been established in the treatment of peritonitis of intestinal origin. After testing the stability of antibiotics in the presence of various hemostatic materials, Correll and Wise[4] concluded that penicillin showed no loss of potency with gelfoam.®

In view of these facts we have outlined the following series of experiments: (1) to test the risk of a two-layer open intestinal anastomosis in unprepared colon; (2) to evaluate the effect of gelfoam® on this type of anastomosis and (3) to determine the protection afforded by impregnation of penicillin in the gelatin sponge placed against the anastomosis.

PROCEDURE

This experimental study was divided into four series, namely, (control ten animals), plain gelfoam® (ten animals), crystalline penicillin-gelfoam® (ten animals) and procaine-penicillin-gelfoam® (five animals). A total of thirty-five unprepared mongrel male and female dogs weighing 5 to 20 kg. were used. Intraperitoneal nembutal® anesthesia was given. Through a midline lower abdominal incision the descending colon was brought out of the abdomen and packed off from the cavity and wound edges. The colon was kneaded free of fecal content and Scudder intestinal clamps were applied to the two limbs of the loop. After ligating several small mesocolic vessels clamps were applied and a small segment of bowel was removed. (Fig. 1A.) The open end of each limb was cleaned with dry gauze sponges. An open end-to-end two-layer anastomosis was used, consisting of an inner layer of continuous No. 0000 chromic catgut which inverted the mucosa, and an outer layer of interrupted Halsted sutures of No. 0000 black silk. (Figs. 1B and 1C.) Following closure of the rent in the mesocolon the abdominal wall of control animals was closed.

In subsequent series the serosal silk sutures were held long to facilitate tying the gelfoam® strips directly over the anastomosis. These strips were approximately 2 cm. wide and sufficiently long to encircle the anastomosis completely. (Fig. 1D.)

In the second series the gelfoam® was moistened with normal saline before application in order to simulate more closely the strips used in the third and fourth series. In the third series the gelfoam® was impregnated with 500,000 units of crystalline penicillin.† In the fourth series each strip was impregnated with 600,000 units of procaine-penicillin. Postoperatively all animals were restricted to water and milk for three days, after which regular feedings were resumed.

In the third and fourth series cultures were obtained from the surface of the bowel at the site of the second layer closure of the anas-

† Gelfoam® and crystalline penicillin were supplied by the Upjohn Company, Kalamazoo, Mich.

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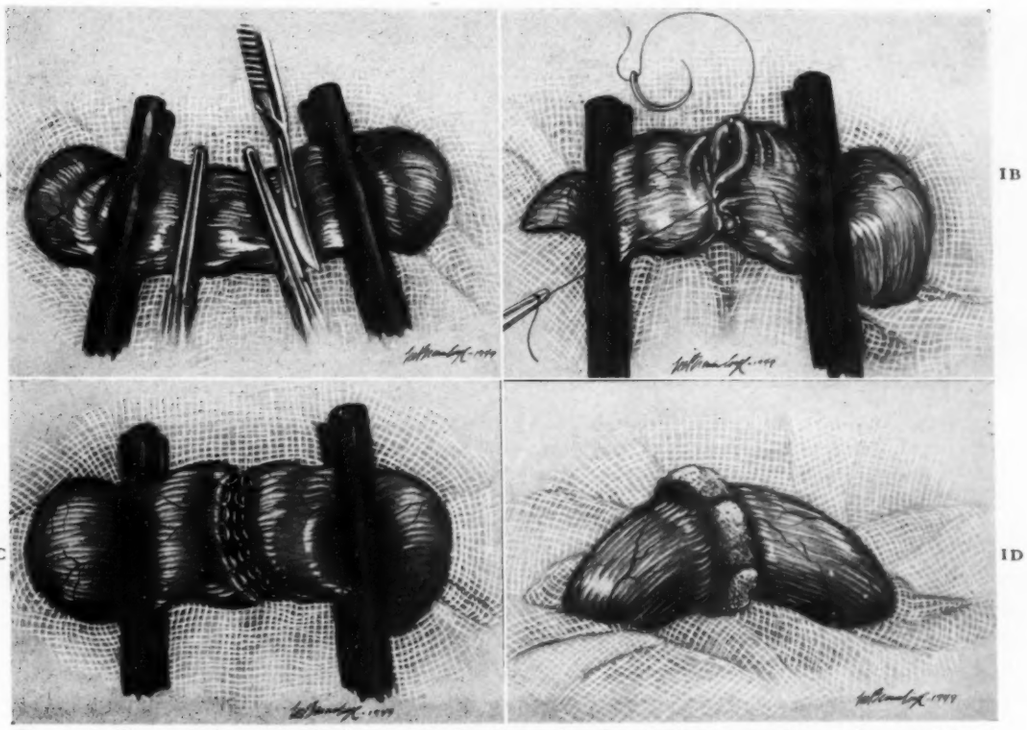


FIG. 1. A, First step in removal of segment of colon; B, first layer of anastomosis nearly completed; C, second layer or serosal suture completed; D, gelfoam strip placed and tied at the line of closure.

tomosis. At autopsy cultures were taken from the abdominal cavity of all animals which died or were sacrificed.

In order to determine the status of anastomoses the majority of animals surving in each series was sacrificed between the fifth and fourteenth day postoperatively. Specimens of bowel were preserved in 10 per cent formalin for photography and microscopic study.

RESULTS

In the control series all ten dogs survived surgery without evidence of morbidity. Four of the six animals which were sacrificed had rather marked adhesions about the anastomoses. Suture lines were intact and no abscesses were present.

In the plain gelfoam® series three dogs expired on the fourth, fourth and fifth postoperative days. Autopsy revealed disruption of the anastomosis in each instance with generalized peritonitis and marked liquefaction of the gelfoam.® Four of the surviving animals were sacrificed from the fifth to the twelfth day. In these, many adhesions and considerable liquefaction of gelfoam® were noted. The anastomoses, however, were intact.

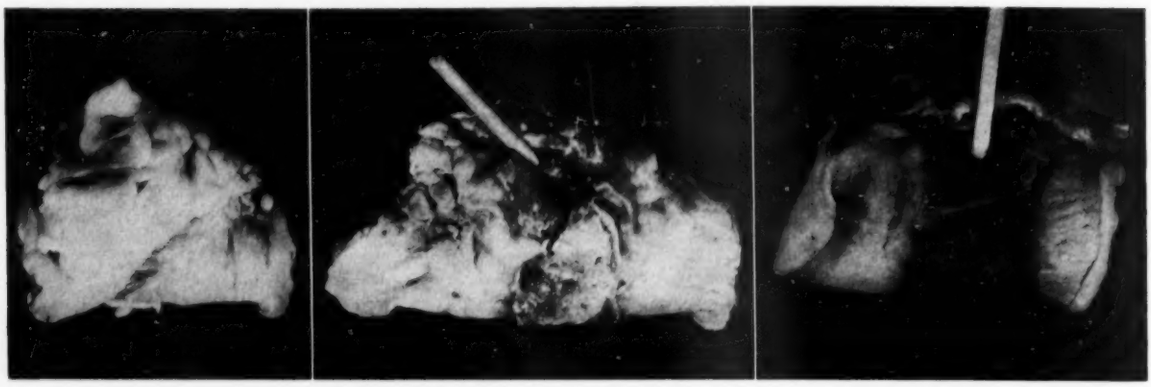
In the penicillin-gelfoam® series all ten dogs survived. An autopsy in the eight dogs which were sacrificed between the fifth and ninth postoperative days the anastomoses were intact; the gelfoam® was solid with a glistening smooth surface and adhesions were strikingly minimal.

In the procaine-penicillin-gelfoam® series one dog died of peritonitis due to perforation of the anastomosis. In three of the four surviving animals which were autopsied between the seventh and twelfth days there were marked adhesions with abscess formation and associated peritonitis. (Table 1, Figs. 2A, B and C.)

Fifteen operative cultures obtained yielded primarily coliform organisms and alpha and beta streptococci. Growth was recorded as heavy only in three and surprisingly enough was sterile in three. Postmortem cultures from eight animals of the crystalline-penicillin series revealed a few colonies of coliform organisms. Only one yielded growth of a few streptococci.

COMMENTS

Although we are concerned with the effect of gelfoam® on intestinal anastomosis, we are concerned more directly with the effect pro-



2A 2B 2C

FIG. 2. A, Sample specimen from series 1, control group; B, specimen of series 2, plain gelfoam group. Pointer indicates site of perforation of anastomosis. The gelfoam appears fragmented and liquefied; C, specimen of series 3, crystalline penicillin gelfoam, pointer indicates the gelfoam at anastomosis intact.

duced by the surface contamination which is an ever present danger following bowel surgery. Contamination has been minimized by the use of a two-layer anastomosis. This technic also simulates more closely the usual type used in human bowel closure. Adhesions formed about the line of closure in the control dogs were sufficient to localize the contaminants and allow normal body defenses to handle the situation. However, when a culture medium such as gelfoam® was placed at the disposal of these contaminating bacteria, the infection became rapidly accelerated. With this increased infection on the bowel surface the anastomosis failed to heal, which in turn resulted in abscesses, perforation and peritonitis. Massive dosage of penicillin was then impregnated into gelfoam® which was found to decelerate the infection. Cultures obtained revealed the fact that the streptococci were eliminated almost entirely. The remaining coliform organisms were not of sufficient virulence to produce a marked intraperitoneal reaction. It is agreed that normal body defensive mechanisms can better cope with the coliforms in the absence of gram-positive organisms.

TABLE 1

Series	No. Operated Upon	Mortality	Autopsies		
			No. Examined	Findings	Animals with Marked Adhesions
Control	10	0	6		4
Plain gelfoam	10	3	7	3-Peritonitis with gross perforation	6
Crystalline penicillin gelfoam	10	0	8	5-Only serous fluid	2
Procaine penicillin gelfoam	5	1	5	2-Peritonitis 2-Abscess	5

It was reasonable for us to assume perhaps that a more prolonged effect of the penicillin might be attained even in the peritoneal cavity with the use of a procaine-penicillin combination. However, the results in the fourth series show that protection by this preparation was most inadequate. Little can be said at this time in regard to the breakdown or absorption of procaine-penicillin in the peritoneal cavity.

CONCLUSIONS

1. Gelfoam® in apposition to intestinal anastomoses increases the danger of perforation and fatal peritonitis in dogs.

2. Impregnation of this gelfoam® with crystalline-penicillin (500,000 units) is effective in

preventing perforation of the anastomosis or local abscess formation.

3. Impregnation of gelfoam® with a procaine-penicillin preparation is ineffective in the dosage given (600,000 units).

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Cancer of the vulva is extremely rare, being found in only one-half of 1 per cent of all patients with cancer. Many cases of vulvar cancer are hard to classify on the basis of our present knowledge so that comparison of results by various forms of therapy cannot justly be made. Recently, 313 such cases were studied, mainly for statistical purposes, by J. P. Palmer et al., and they came to the conclusion that a more adequate classification is urgently needed. In the meantime, the reader may be surprised to learn, on the basis of present studies they fail to find definite evidence that the absolute cure rate is any better when the very radical Basset excision of the vulva and of all the inguinal lymph nodes is done than when less radical measures are adopted, such as vulvectomy with incomplete removal of inguinal glands with or without use of other therapeutic measures, as radiotherapy. (*Richard A. Leonardo, M.D.*)

FASCIA LATA REPAIR OF MASSIVE VENTRAL HERNIAS

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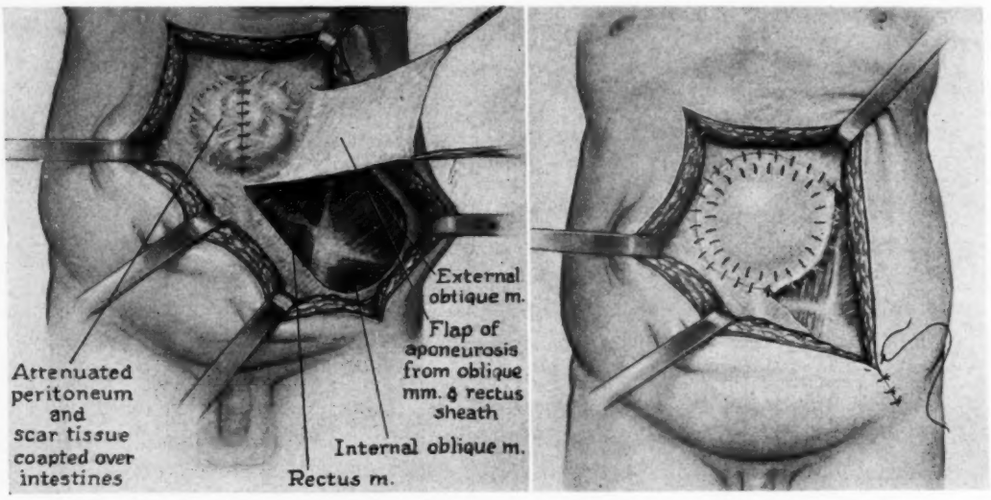
ONE of the most difficult problems in surgery has always been the repair of massive recurrent and postoperative ventral hernias. In the early days of our practice, when suture material was confined largely to catgut, we were consulted by a number of patients with hernias so huge that operation by the standard Mayo imbrication procedure could not possibly have been successful. The plight of these unfortunate patients started us on a search for a practicable method of repairing such defects.

A review of the literature revealed that many ingenious methods had been tried. Muscle transplants, fascia flaps, buried skin grafts and even periosteum and bone as well as various heteroplastic materials had been employed with some success but none had become popular because of the disabilities they had left behind. One group of investigators experimented with sutures and grafts of fascia or tendon preserved in alcohol. Others studied the fate of heterofascia grafts. Often the observation was made that these dead substances were transformed by "absorption and substitution" into bands of living tissue, especially when they had a function to perform. The conclusion was finally reached, however, that fresh autogenous fascia gave superior results. Recently success has been reported with tantalum mesh, which becomes completely enveloped in fibrous tissue, but this we have not tried. We took our inspiration largely from the work of Gallie and LeMesurier who filled in defects with woven strands of fascia lata, from Singleton who reported good results with fascia transplants, and from Wangensteen who did pioneer work with reflected flaps of abdominal aponeurosis and pedicle grafts of fascia lata.


External oblique m.
Flap of aponeurosis from oblique mm. & rectus sheath
Attenuated peritoneum and scar tissue coapted over intestines
Internal oblique m.
Rectus m.

1 2

FIG. 1. Case 1. Flap of anoneurosis from lower abdomen is raised to cover defect in mid-abdominal wall which developed after cholecystectomy.
FIG. 2. Case 1. Reflected flap is fixed over upper abdominal defect with wire sutures. Defect in lower abdomen apparently filled in with heavy scar tissue as wall is now firm.

Of all the methods proposed fascia lata sutures and grafts appealed to us as the best. There are a number of reasons for our choice. Fascia is a homogeneous tissue which can be removed from the thigh without ill effects. When transplanted it causes no unfavorable tissue reaction. It is living tissue which promptly becomes an enduring part of the repair. Fascia is a normal supporting tissue of the body. Furthermore it is charged, in the form

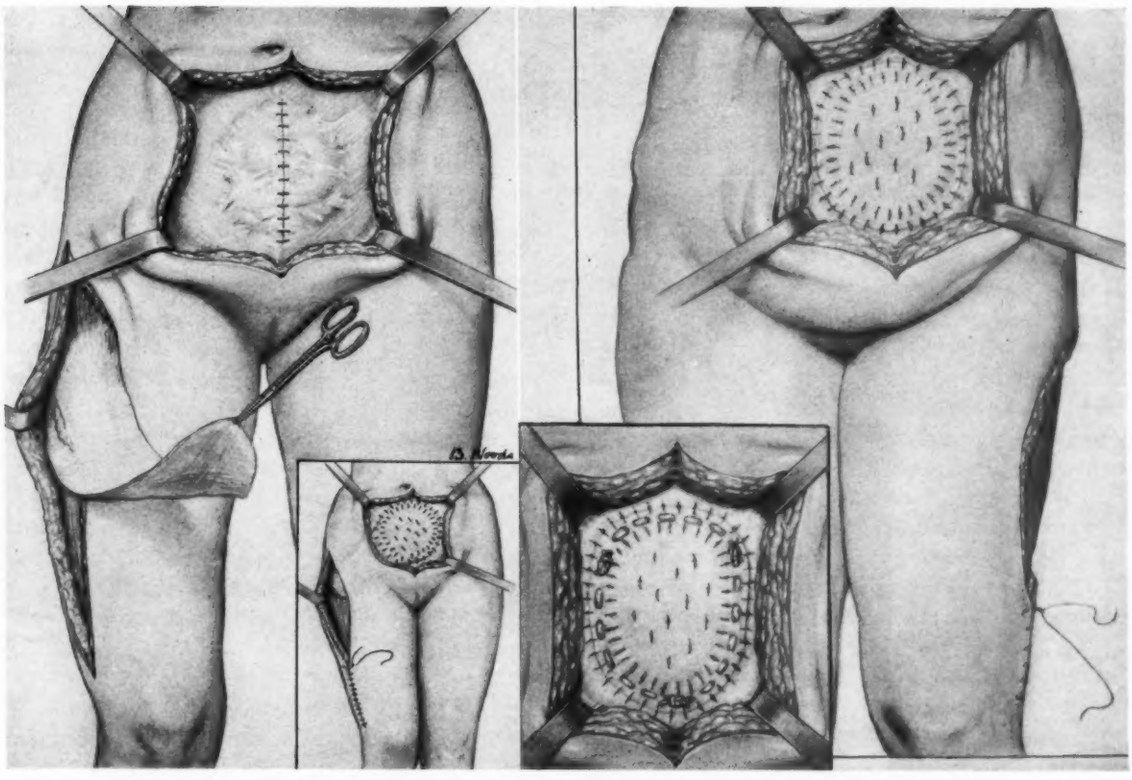


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FIG. 3. Case II. Pedicle graft of fascia lata is drawn under skin and over inguinal ligament to cover defect in lower mid-abdominal wall.

FIG. 4. Cases III to VIII. Free transplant of fascia lata is fixed over the large ventral defect with wire sutures. Fascia lata sutures from the other thigh may be used to reinforce the repair, as shown in inset.

of scar tissue, with the function of anatomic repair. Unlike the skin it is normally buried and does not have to be absorbed, infiltrated and transformed in order to survive and carry on its function. Unlike tantalum it does not remain in the tissues as a foreign body which must be overgrown to protect the surrounding tissues. In a word, either as sutures or as grafts fascia seems to us the ideal material for the repair of intractable hernias.

Since 1923, therefore, we have used fascia sutures to reinforce repairs with non-viable sutures. We have also tried flaps reflected from the abdominal aponeurosis (Figs. 1 and 2) as well as pedicle grafts (Fig. 3) and free grafts (Fig. 4) from the fascia lata. All of these methods have been satisfactory and have produced good results, but at present we routinely use the free graft of fascia lata. We find that free grafts heal just as well as pedicle grafts and perhaps better. With a pedicle graft the leg must be retained in flexion until the pedicle is severed. Mobilization of the patient, therefore, is delayed. When a free graft is used, the patient can be up and around within a few days. He is more comfortable and healing probably occurs sooner and is more firm since a negative nitrogen balance is decreased by early mobilization.

TECHNIC

The free graft has the additional advantage that the technic is less difficult. An incision is made over the hernia and the area is carefully explored. The peritoneum and attached scar tissue are coapted with chromic catgut. If the aponeurosis cannot be imbricated without undue tension, it is at least brought together when possible with interrupted cotton sutures.

A long incision is then made in the lateral aspect of one thigh and a sufficient area of fascia lata is removed from the iliotibial tract and its fascia lata extensions. This is kept moist and at body temperature until used. The superficial fascia and skin are closed over the defect in the thigh. It is not necessary to coapt the margins of the fascia. The heavy scar tissue which replaces it seems to be quite adequate to

prevent bulging of the muscles; and although in some cases healing is slow, we have not known any permanent disability to result. There may be some serous accumulation, especially in obese patients, but this does not seem to be an important complication. When it is necessary to use both a graft and fascia sutures, the sutures are removed from the contralateral thigh with a Masson fascia stripper.

The free graft is placed over the defect, overlapping the sound margins of aponeurosis at least 1 inch and preferably more. It must fit smoothly but without tension and is fixed in place with a double row of interrupted wire sutures tied in square knots around the margin. It is also fastened to the underlying tissues at intervals over its entire area.

Fascia sutures may be inserted in two ways. We formerly used an over and over stitch, passing the suture through the graft, then through the surrounding aponeurosis and back through the graft until the end was reached. The end was tied to the next suture in a square knot, then transfixed and tied with a cotton suture. Lately we have been using a running stitch, passing the suture through the graft and the underlying margins of the aponeurosis. (Fig. 4.) This type of fascia suture is very flat and smooth and seems to provide firmer anchorage than the over and over stitch.

Of the non-viable sutures we have found either cotton or stainless steel wire to be satisfactory. We rather prefer, however, to use interrupted sutures of No. 36 wire, placing the stitches reasonably close together. We believe that this is important. Heavier sutures placed farther apart require a larger bite of tissue. There is greater tension on each suture, the stitches are more apt to cut out and tissue necrosis is more likely to occur.

The same thing applies to fascia lata sutures. We cut them 2½ to 3 mm. wide and use an ordinary Mayo needle, No. 4 or 5, with a long eye. The small caliber prevents tearing of tissues. In most of our illustrations in order to simplify the drawings fascia sutures are not shown, but we do use them when indicated. We have had good results with both cotton and wire sutures without fascia; but when the tissues are of unusually poor quality, we believe the chances of success are enhanced by the addition of fascia sutures. They do not pull out so readily, perhaps because of their elasticity, and they are promptly incorporated as a living part of the repair. They thus have the double advantage of providing permanent mechanical support and attachment by scar tissue.

We believe that most of the reported failures with fascia repairs have been due to inexpertness in their use. A fascia graft must be firmly fixed but not under tension. Fascia sutures must be smoothly and snugly placed but without tension. It is not necessary to fix every stitch with non-viable sutures although a suture through the end alone will not hold. The fascia ends must be tied and the knot transfixed and tied with cotton.

Fascia and Infection. An increased incidence of infection with fascia has been reported by some writers. However, we have not observed this and see no reason why it should occur if the fascia is properly handled. In two of our most difficult cases surface infections developed but they did not penetrate below the fascia graft or infiltrate the deep tissues. Although the infection retarded healing, the eventual result was entirely satisfactory in both cases. When fascia is used, we have noted perhaps a little more than the usual tendency to develop serous accumulations. This can be largely overcome by meticulous hemostasis, snug apposition of the fascia to contacting tissues and adequate drainage.

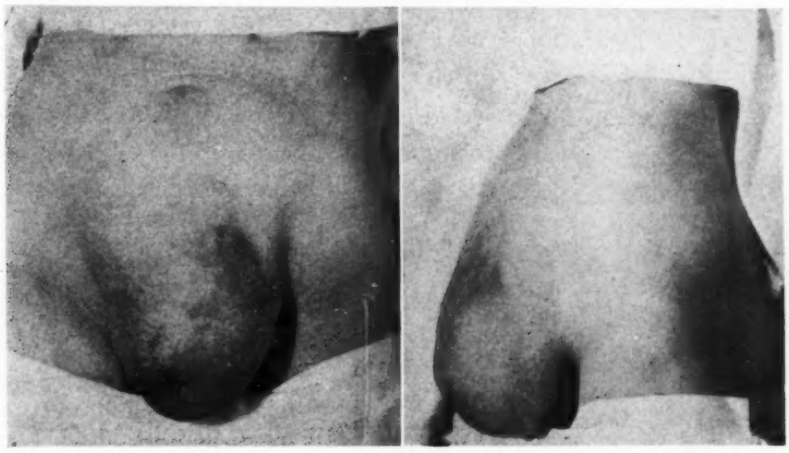
CASE REPORTS

The following cases are presented because they illustrate the several methods we have tried for repair of massive ventral hernias. All the repairs were successful although these were the largest ventral hernias that we have treated.

CASE 1. The patient, a white man aged thirty-four, weighing 282 pounds, came to us on April 3, 1944, complaining of multiple hernias which had developed in the scar of a cholecystectomy performed seventeen months previously and followed seven months later with an unsuccessful ventral herniorrhaphy with silk and wire sutures.

Examination revealed a very long transverse incisional scar in the right upper quadrant, with a medial hernia 7½ cm. in diameter and a lateral hernia measuring 13 cm. The aponeurosis was widely separated and in one area there was a sinus containing pus.

On May 20, 1944, both hernias were repaired using wire and fascia lata sutures. The medial



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FIGS. 5 and 6. Case II. Large ventral hernia which developed after hysterectomy for carcinoma. Hernia was successfully repaired with a pedicle graft from the iliotibial tract.

hernia was too large for a transverse closure and was closed longitudinally under marked tension. A permanent repair of the lateral hernia was secured but the medial hernia recurred as expected. On August 21st after twelve days of hospital preparation the medial hernia was again closed by a Mayo imbrication procedure using cotton reinforced by fascia lata sutures. It recurred in about three months.

On March 19, 1945, a fascia flap from the aponeurosis in the lower left abdomen was dissected free, leaving the upper margin attached. The flap was reflected over the hernial defect and fixed with cotton and fascia lata sutures. (Figs. 1 and 2.) Apparently the fascial defect in the lower abdomen regenerated or was filled in with strong scar tissue, for the wall remained firm.* Six years later there was no indication of further herniations.

CASE II. The patient, a white woman aged fifty-two, consulted us on April 26, 1945, giving a history of hysterectomy for carcinoma seven years previously complicated by peritonitis and followed with a lower abdominal hernia. This gradually became larger and caused so much discomfort that household tasks became almost impossible.

Examination showed multiple scars in the lower abdomen and a large incisional hernia through an oval-shaped defect about 15 cm. long and 13 cm. wide. (Figs. 5 and 6.)

At operation on May 7, 1945, because there was insufficient tissue for imbrication the margins of the aponeurosis were coapted with interrupted cotton sutures, but under so much tension as to jeopardize the result. A large area of fascia lata was incised, therefore, and dissected upward, leaving it attached at the upper margin. The flap was brought over the inguinal ligament under the skin and sutured over the defect with cotton. (Fig. 3.) The thigh was placed in flexion and supported with adhesive tape. On the ninth postoperative day the graft was severed from its pedicle through a small thigh incision.

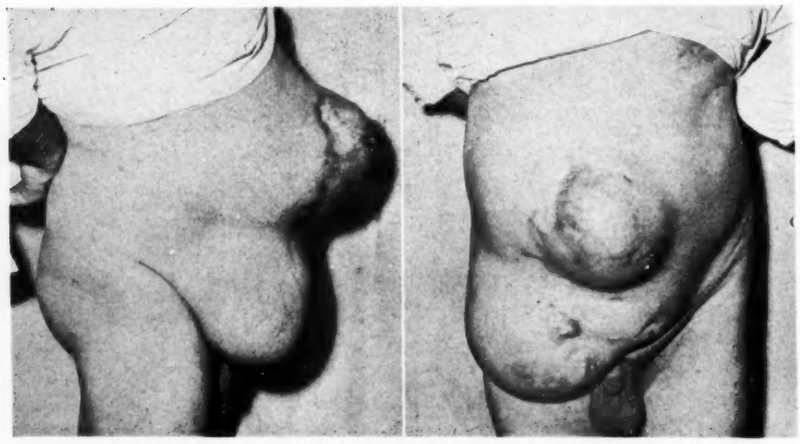
Examination five years later revealed good integrity of the entire abdominal wall and no bulging of the leg muscles.

CASE III. The patient was a white man aged fifty-one weighing 205 pounds. An umbilical hernia had developed on February 27, 1939, while the patient was lifting. When we first saw him, two unsuccessful attempts had been made to repair the hernia; and at the time of the last recurrence another hernia had developed concurrently in the right lower quadrant.

On examination we found a large midline incisional hernia in the upper abdomen, with a ring approximately 10 cm. in diameter. There was also a huge, firm, irreducible mass in the right lower quadrant not connected with the inguinal canal. (Figs. 7 and 8.)

We repaired the lateral hernia on March 21, 1945. A large section of small intestine was replaced in the peritoneal cavity and a portion of the hernial sac measuring 25 by 11 cm. was resected. The wound was closed transversely and the aponeurosis was imbricated with cotton

* Koontz noted replacement of excised rectus sheath in dogs with fibrous tissue much heavier than the original sheath (*Ann. Surg.*, 83: 523–36, 1926).



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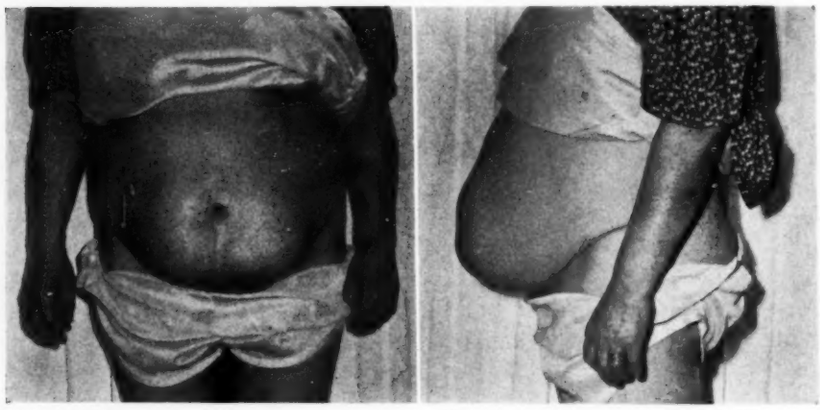
FIGS. 7 and 8. Case III. Condition of patient after two attempts to repair a primary umbilical hernia. Fascia lata sutures were sufficient for repair of lateral hernia, but medial hernia required a free graft of fascia lata.



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FIGS. 9 and 10. Case IV. Two large ventral hernias which developed after removal of an ovarian cyst. Both defects were covered with a single large free transplant of fascia lata.

and fascia lata sutures. Healing was delayed for three months by serous drainage and development of two superficial sinuses but eventually was complete.

On November 14, 1946, the mid-abdominal hernia was repaired. The ring was so large that the normal fascia surrounding it could not be approximated. After closing the peritoneum and scar tissue a large transplant was removed from the iliotibial tract and sutured over the abdominal defect with fine wire. Recovery was uneventful. Almost four years after the second repair and five and a half years after the first the abdominal wall was firm and strong in both areas, without any indication of a recurrence.

CASE IV. The patient, a fairly obese white woman aged forty-four, had a right ovarian cyst removed five years before she came to us complaining of upper abdominal pain, nausea and vomiting. Examination revealed two large defects at the upper end of the lower midline incision. The rings were difficult to outline because of the protrusion of the bowel, which was very close to the skin. (Figs. 9 and 10.)

On April 27, 1946, through a transverse incision the peritoneum and scar tissue were coapted with catgut. The margins of the aponeurosis were so widely separated that it was impossible even to bring them together. The entire defect, therefore, was covered with a large sheet of fascia lata from the right thigh which was fixed in place with wire sutures.

The postoperative course was uneventful except for serous drainage from both abdominal

and thigh wounds for a time. Four years later the abdominal wall was firm and there was no evidence of recurrence.

CASE V. The patient was a white woman aged fifty-six weighing 180 pounds, upon whom we did a two-stage Mikulicz operation in November, 1944, for a malignant tumor of the sigmoid colon, which was followed with evisceration. On May 23, 1946, the patient returned with a large incisional hernia through a defect in the left rectus incision. (Fig. 11.)

At herniorrhaphy on July 12, 1946, the aponeurosis was found to be retracted laterally so far that it could not be coapted. After the peritoneum and attenuated scar tissue were closed, the defect was covered with a large free transplant from the left iliotibial tract sutured to the underlying structures with fine wire.

Four years after operation the abdominal wall was firm and there was no evidence of a recurrence.

CASE VI. The patient, a white woman aged sixty-one, came to us August 29, 1946, for treatment of a large bilateral intrathoracic nodular goiter and a huge ventral hernia. The goiter had been present for twenty-five years, had gradually grown larger and was causing some choking and pressure symptoms. The hernia had appeared eight months after a hysterectomy and bilateral salpingo-oophorectomy performed nine years previously. It had gradually enlarged and had become painful but was always reducible. Physical examination revealed a low midline scar with the hernia in the lower portion. The ring was approximately 10 cm. in diameter.

Total thyroidectomy was performed on September 20, 1946, as there was adenomatous degeneration of the entire gland. The patient made a good recovery. She was placed on thyroid extract and her health improved.

Herniorrhaphy was performed on August 20, 1947. The entire abdominal wall had broken down in the lower portion of the incision and there were many adhesions which were freed. The aponeurosis could have been closed only under extreme tension, and therefore the defect was covered with a large free transplant from the right iliotibial tract sutured in place with wire. (Fig. 4.)

Convalescence was uneventful except for collection of serum in both abdominal wall and thigh. This cleared up under treatment and

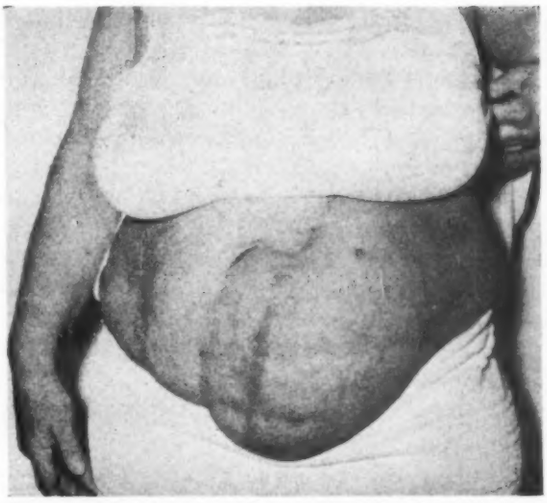

FIG. 11. Case v. Massive ventral hernia following two-stage Mikulicz operation for malignant sigmoid tumor; cured by free transplant of fascia lata.

examination three years after operation disclosed good integrity of both wounds.

CASE VII. The patient, an obese white man aged forty-eight, came to us on January 19, 1949, complaining of pain and bulging in the abdomen which had started abruptly a week before while lifting a heavy weight. He gave a history of a right indirect inguinal hernia, which had been repaired in February, 1945. Infection had developed and a granuloma had been excised from the scar in August, 1945. Appendectomy, performed in November, 1947, had been followed with evisceration on the eighth postoperative day and a secondary closure. Since his recovery the patient had been wearing an abdominal support.

Examination revealed a right rectus scar with a hernia of football size or larger in the upper angle near the umbilicus. The ring was difficult to palpate because of the size of the hernia, but it appeared to be about 7½ to 10 cm. in diameter.

Herniorrhaphy was done on March 24, 1949. A semi-elliptical longitudinal incision was made, excising the old scar. The peritoneum and scar tissue were closed with chromic catgut. The defect in the rectus sheath measured 16 to 17 cm. across and closure was impossible. A sheet of fascia lata 25 by 18 cm. in size was sutured over the defect with wire. Numerous small stab incisions were made in the graft to facilitate drainage, and two Penrose drains were inserted between the transplant and the superficial tissues. Recovery was uneventful

except for serous drainage from the abdominal wound which cleared up promptly.

A year and a half later the abdominal wall was strong and firm, with no sign of recurrence although the patient had returned to heavy labor.

CASE VIII. This patient, a white woman aged sixty-eight, weighing 158 pounds, underwent a cholecystectomy in 1934. About a month afterward a large incisional hernia developed. This was constant in size and caused no trouble until November 4, 1949, when the patient fell. She was admitted to the hospital suffering from a large incarcerated hernia, with nausea, vomiting and pain.

At operation on November 11th the sac was excised and the peritoneum and attenuated scar tissue were closed with catgut. The defect in the aponeurosis was so large that the margins could not be coapted. A large free graft from the right iliotibial tract was sutured over the defect with wire. Three fascia lata sutures from the left thigh were used to reinforce the wire sutures around the margin of the graft in the manner shown in Figure 4 (inset). Multiple small drainage incisions were made in the graft and a Penrose drain was brought out through a stab wound. A Penrose drain was also incorporated in the closure of the right thigh.

There was some serous drainage from the abdominal wound and the right thigh but the patient recovered promptly. Nine months later all three wounds were well healed and firm and there was no evidence of recurrence.

PRIMARY OPERATIONS

The primary operations preceding development of the eleven hernias presented by these eight patients fall into the following three groups:

(1) Operations on the genital tract:
- Hysterectomy for carcinoma followed with peritonitis
- Hysterectomy and bilateral salpingo-oophorectomy
- Excision of an ovarian cyst with twisted pedicle

(2) Operations on the digestive tract:
- Cholecystectomy (two cases)
- Mikulicz's operation for sigmoid carcinoma
- Appendectomy

(3) Operation for hernia due to congenital defect:
- Repair of umbilical hernia

ETIOLOGY OF INCISIONAL HERNIAS

These cases presented a number of conditions generally recognized as causes of failure to heal, as follows: (1) conditions which impair nutrition by restricting intake or absorption of food, such as cholecystitis, intestinal carcinoma and gastric ulcer (present in Case II); (2) obesity, a nutritional or metabolic condition which interferes with formation of connective tissue; the suggestion has been advanced that fat cells are formed at the expense of fibroblasts; (3) serosanguineous effusion which may be due to imperfect hemostasis, some defect in the clotting mechanism, salt and water imbalance or hyproproteinemia with reduction of blood proteins; (4) infection, which apparently was a factor in producing incisional hernia in several of our cases; (5) excess strain on healing tissues because of closure under tension or severe cough (present in three of our cases); (6) longitudinal incision (used at primary operation in all but one of our cases); this type of incision is vulnerable to contraction of the lateral muscles which pulls apart the lips of the wounds; (7) developmental defect, which probably was responsible for the original umbilical hernia in Case III; such defects are not necessarily anatomic but may be a localized weakness of the fibrous tissue resulting from poverty of cellular enzymes responsible for protein synthesis; (8) endocrine imbalance, present in at least three of our patients, which may impair the healing process; (9) malfunction of the adrenal cortex; recent studies have shown that in gastrointestinal cancers the salt and carbohydrate metabolisms are deranged even in the early stages. This is attributed to cortical deficiency.

Danger signs should be constantly borne in mind by every surgeon; and when they are observed, special precautions should be taken to forestall evisceration or herniation. The present concensus is that the cause of imperfect healing is a profound disturbance of protein metabolism, and preoperative treatment should be given to improve the ability to form proteins.

CONCLUSIONS

On the basis of our experience we believe the use of free grafts from the iliotibial tract

to be the most satisfactory method available for repair of massive ventral hernias.

Healing is a function of connective tissue, and its use for this type of plastic surgery is logical on both anatomic and physiologic grounds. Transplants readily become established in their new location, apparently with little or no loss of their original strength.

SUMMARY

A series is reported of large ventral incisional hernias repaired with various technics involving the use of fascia. Good results were obtained with a reflected flap of abdominal aponeurosis, with a pedicle graft of fascia lata and with free transplants of fascia lata from the iliotibial tract. The latter method is the simplest and most satisfactory since it does not interfere with early mobilization of the patient. Wire sutures are preferred to fix the grafts, supplemented by fascia lata sutures when the tissues are of poor quality. Satisfactory repair of less severe incisional hernias may be accomplished with fascia lata sutures, but grafts are required to fill in the larger defects.

ALL of us have been treating high blood pressure (by medical and later by surgical means) without really knowing too much about the mechanism producing arterial hypertension. Of course, the final word has not been said on this subject but according to our present concept, as explained by B. C. Lockwood, arterial hypertension is caused by pressor substances which produce spasm of the arterioles and probably of the small arteries. These pressor substances are the result of renal ischemia associated with a constitutional vascular irritability. This theory is a logical one based upon our present clinical and investigative knowledge of this subject. It will have to stand as our best available explanation of the pathologic physiology of this condition until a newer and better explanation is forthcoming. (*Richard A. Leonardo, M.D.*)

INGUINAL HERNIAS*

SOME CAUSES OF RECURRENCE

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NO surgeon should ever undertake an operation for inguinal hernia without bearing in mind the relatively high recurrence rate as reported in contemporary literature. The surgeon who does approach the operation lightly without bearing this in mind is inviting a higher percentage of recurrences than is necessary. I shall make no attempt to analyze the current statistics on recurrences. We all know that they vary from between 1 or 2 per cent to 20 per cent or more. We also know that it is very difficult to get correct and accurate statistics. Suffice it to say that no surgeon can assure any patient with inguinal hernia that the operation will certainly cure him.

This paper is concerned with some of the causes of recurrence following operation for inguinal hernia. It is presumed to start with that we are dealing with those operations performed by surgeons with a thorough knowledge of the anatomy of the inguinal region and of the surgical principles involved in hernia repair. The object of this paper is to discuss the causes of recurrence in the hands of well qualified surgeons. We all know that such cases occur entirely too frequently. I do not propose to include in my remarks any such trite reasons for recurrences as are often given in articles on this subject such as poor asepsis, incomplete hemostasis, improper incision or bad choice of operation.

Over the years it has been generally agreed that in indirect hernia a *sine qua non* is high ligation of the sac. This means, of course, that the sac should be dealt with in such a manner so as to leave no process or teat of peritoneum projecting from the peritoneal cavity through or into the internal inguinal ring. This can be done by dissecting the sac free from below well up through the internal ring and transfixing and ligating it there. It may also be done by the method of LaRoque,[1] doing a muscle splitting incision above the internal ring, opening the peritoneal cavity, invaginating the sac from below up into the peritoneal cavity and dealing with it there, thus securing very high ligation. Recently Jacobson[2,3] has advocated using LaRoque's approach without invaginating the sac into the peritoneal cavity but excluding the opening of the sac from the peritoneal cavity by suturing the upper flap of the incised parietal peritoneum to the lower border of the ring forming the neck of the sac. By so doing he leaves the sac in place, simply splitting it open longitudinally, maintaining that its presence adds to the fibrous strength of the floor of the inguinal canal. He reports excellent results with this method.

In a case of direct inguinal hernia the important thing is to close the fascial defect in Hesselbach's triangle. There are a number of ways of doing this. One should always make sure when dealing with either indirect or direct hernia that it is not the pantaloon type. When operating upon either type of hernia a sac of the other type should be searched for. LaRoque's approach with a finger in the peritoneal cavity greatly facilitates this search and also enables the operator to explore the femoral canal. Obviously, it is futile to operate for direct hernia and leave an indirect sac unnoticed or vice versa.

It is not within the scope of this paper to discuss the relative merits of the various standard operations for inguinal hernia. We all know that good results have been obtained from all of them. I simply want to discuss some general principles the observance of which I believe will diminish the recurrence rate no matter what type of operation is used in the repair. Four of the principal causes of recurrence, so far as the operation itself is concerned provided the sac has been properly dealt with, are: (1)

* From the Department of Surgery of the Johns Hopkins University School of Medicine, Baltimore, Md. Read before the Association of Surgeons of the Southern Railway System, Forty-ninth Annual Meeting, Washington, D. C., May 25, 1950.

The presence of areolar tissue left on important structures which are to be sutured together; (2) tension; (3) the use of absorbable sutures and (4) poor tissues.

Areolar Tissue. The significance of thoroughly removing areolar tissue from all important structures before they are sutured together was demonstrated[4] experimentally about twenty-five years ago. The presence of areolar tissue on any structures to be sutured together results in a poor, filmy, flimsy type of union which has no strength whatever. Thorough removal of areolar tissue from such structures as muscle or fascia before they are sutured together brings these structures into more intimate contact and results in a very firm union. In operating for recurrent hernia every surgeon has seen the internal oblique muscle thoroughly united to Poupart's ligament throughout part of the suture line but pulled away throughout the remaining portion. It might possibly be that areolar tissue was cleaned away in a portion of the suture line and not cleaned away in the remaining portion. Tension undoubtedly plays a part. Be that as it may I am convinced that a great many surgeons do not pay enough attention to removing areolar tissue thoroughly from important structures before they are sutured together.

Tension. We have all been taught that it is improper to suture structures together under tension, especially in operations for hernia, yet how often we have seen structures brought together under such tension that the feat would have been impossible but for the heavy suture material used in the repair. There are cases, of course, in which some tension is unavoidable. However, in operating for inguinal hernia utilization of the relaxation incision in the sheath of the rectus introduced by Halsted[5] many years ago will in most cases entirely eliminate any tension in the structures which are to be sutured together. This relaxation incision is made from the symphysis upward for approximately 3 inches and should be made over the center of the rectus muscle. Exposure of the rectus sheath is easily accomplished by simply lifting up the inner flap of the aponeurosis of the external oblique and separating it from the rectus sheath by blunt dissection with the finger. The incision should not be made near the edge of the rectus muscle; because when the conjoined tendon is sutured to either Poupart's or Cooper's ligament, the cut edge of the sheath is retracted away from the muscle leaving a gap along the lateral edge of the rectus which weakens the abdominal wall at this point.

Absorbable Sutures. Everyone will agree that the cure of inguinal hernia depends upon the structures used in the plastic repair remaining in close apposition until firm healing is obtained. It is also generally agreed that there are many variables in the rate of absorption of absorbable sutures such as catgut and that no one can tell whether these materials will be absorbed rapidly or will persist until healing is complete. Unless they do remain in place and retain their tensile strength until healing is complete, it is obvious that recurrence will result. Many surgeons have reported higher recurrence rates with absorbable than with non-absorbable sutures. Parsons[6] reported a recurrence rate of 12.7 per cent when catgut was used and only 3.5 per cent when silk was used. For these reasons it seems apparent that in hernia repair non-absorbable sutures should be used and that to use absorbable sutures is only to invite disaster. I personally prefer silk or cotton and of a fairly large caliber so that it will not cut through. These sutures should be tied snugly but not tightly. I do not like wire sutures because they tend to cut through.

The only objection that I hear raised to silk or cotton is that if the wound becomes infected a sinus tract persists until the offending suture is removed. However, infections in clean wounds are very rare these days and the occasional one can be avoided by giving penicillin postoperatively for a few days.

Poor Tissues. Large direct hernias, large indirect scrotal hernias of long-standing and recurrent hernias are the types which are prone to have poor tissues. Often there is no transversalis fascia to be found. A relaxation incision in the sheath of the rectus aids in bringing the poor structures into apposition. Various accessory methods have been used to supply the defect such as flaps of fascia, free transplants of fascia, preserved sheets of fascia[7] and autogenous[8,9] and preserved[10,11] strips of fascia. All of these methods have been used with varying degrees of success. For the past two years, in those patients with poor tissues and large defects I have been using a piece of tantalum mesh in Hesselbach's triangle to reinforce the first suture line[12] which is generally the conjoined tendon to Cooper's ligament. The lapse of time is too short to evaluate this method but so far

there has been only one failure. Judging from the way fibrous tissue infiltrates tantalum mesh experimentally,[13–17] there is every reason to believe that ultimate results will be better than those hitherto obtained by other methods.

It is universally agreed that sliding hernias afford a higher recurrence rate than the ordinary type. I believe that this has been due to inadequate reduction of the sliding hernia in trying to replace the involved viscus in the peritoneal cavity by pushing it up from below. LaRoque's approach affords a better chance of completely reducing the sliding hernia and properly containing it in the abdominal cavity than does the old orthodox method. The utilization of this approach for sliding hernia has recently been lucidly described by Carrington Williams.[18]

Even with this approach the operation is not always easy. Within the past year I have had two cases of large scrotal sliding hernias in which the mass could not be reduced through the internal ring although using LaRoque's approach. In both these instances it was necessary to cut across the oblique muscle between the abdominal incision and the internal ring thus making the reduction easy. The incision through the oblique muscles was made at the linea semilunaris so there would be fascial structures utilizable in suturing the structures together again.

It has long been considered that the bilateral operation rendered the recurrence rate higher. A recent article gave a much higher recurrence rate when the bilateral operation was performed than when each side was done separately. I believe that the bilateral operation can be done uniformly successfully if the patient has reasonably good structures and adequate relaxation incisions are made in the sheath of the rectus on each side. The important thing is to perform the operation without tension. Even though a bilateral operation had been originally planned, whenever I encounter such a large defect or poor tissues in operating upon the first side and think it inadvisable to do both sides at once I do not hesitate to stop after doing the first side and later explain the reason for it to the patient. If the patient consents, I operate upon the other side in about a week or ten days. My one failure during the past four years was a bilateral case in which I unexpectedly encountered very poor tissues and a big defect on the second side necessitating a great deal more tension than was desirable. The good structures on the first side had afforded no inkling of this. A small piece of tantalum mesh was used to reinforce the poor structures but I know now that the piece used was not nearly large enough. The hernia recurred in a few months and was immediately repaired again, this time using a larger and more adequate piece of tantalum mesh. At the present time (only a few months postoperatively) the site is very strong and I have every reason to believe it will remain so.

Patients with recurrent hernias especially are often told by surgeons that it will be necessary to remove the testicle in order to cure them. It is my belief that this is seldom true. The cord is rarely a deterrent to the cure of a hernia. Besides a great many patients will not submit to operation if they know they are thereby going to lose a testicle. However, I have had two cases in the last year in which I believed it desirable to resect the cord although the testicle was left. Both of these were cases of recurrent hernias. In the first patient the cord came directly through the abdominal wall at the internal ring and did not come through in the usual oblique manner. The opening through which the cord left the abdominal cavity was so large and so surrounded by dense scar tissue that I felt sure the opening could not be closed satisfactorily if the cord was left coming through it. Therefore, the cord was ligated at both the internal and external ring and the intermediate portion resected. This allowed an adequate closure of the internal ring. In the second case the cord was so fanned out and distorted from two previous operations that it was impossible to salvage it and it was dealt with in the same manner as the first case. Neither of these patients underwent atrophy of the testicle although the second patient had been operated upon so recently that it is impossible to say what the ultimate outcome will be. Burdick and Higinbotham[19] reported 200 cases with resection of the cord. Many of the testicles atrophied and some completely disappeared but it was surprising how many apparently remained normal. However, gangrene occurred in four of the 200 patients. Grace and Johnson[20] state that necrosis of the testicle occurs only when it is disturbed from its normal attachments during the resection of the cord.

I am convinced that a great many recurrences occur early, sometimes even before the

patient leaves the operating table. The cause of such recurrences is straining resulting in either the breaking of sutures or the tearing of them from the structures in which they have been placed. Recently while operating upon a big muscular man for a large ventral hernia under cyclopropane the anesthetist attempted to change the cannister while the patient was under only a light anesthesia. The result was that the patient began straining heavily and broke the mattress sutures of heavy, black silk which had already been placed. These sutures broke directly under my vision and with a loud report. I am convinced that such an instance often happens after the wound is closed due to the patient's straining under anesthesia. A great many anesthetists believe that a patient should be practically awake by the time the operation is over. We often see anesthetists at the end of an operation, with the patient almost awake, start sucking out his air passages thereby inducing violent straining and coughing. Nothing could be worse for a freshly made suture line. I personally perfer my patients to stay beyond the straining stage until they get back to their room. As soon as they start moving around in bed the least bit, a dose of morphia large enough to keep them quiet until the anesthetic has worn off should be given. When I finish an operation and find that the patient is almost awake, I have the morphia given before the patient returns to his room. Once the patient is out from under the influence of anesthetic, pain will keep him from straining enough to injure his suture line.

Straining at stool, vomiting and coughing also put a tremendous strain on suture lines. As soon as the patients are able to take it after operation, I give them cellothyl, konsyl, metamucil, mucilose, saraka or one of the other cellulose or gum substances which simply forms bulk and makes for a large, soft, easy stool. This is kept up throughout the convalescent period and afterward if necessary, and effectually eliminates all straining at stool even in the most constipated people. The Levin tube is is used in people who continue to wretch and vomit postoperatively. In patients who have been operated upon before and know they habitually have prolonged vomiting periods after anesthesia the Levin tube is brought into the operating room while the patient is still under anesthesia in order to avoid any straining which might occur by insertion of the tube when the patient is awake. Patients who develop coughs after anesthesia should be given sedatives, inhalations or whatever is necessary to keep the coughing at a minimum. Abdominal distention can be reduced by the taking of solid food early. Naturally spinal anesthesia would eliminate some of the straining mentioned but spinal anesthesia is not always the anesthetic of choice.

I strongly believe that the dressing (a small piece of flat gauze) should be firmly strapped on with 3 inch adhesive tape going all the way across the abdomen thus giving the entire involved area of the abdominal wall strong support. Not only do the patients feel more comfortable and secure with this type of dressing but also the tight strapping helps to take the strain off the suture line should any of the straining mentioned previously inadvertently occur. Successful hernia repair is the result of infinite pains and close attention to every minute detail.

I also strongly believe that early ambulation is a deterrent to recurrence. It not only stimulates healing by improving the circulation and helping to keep the patient in positive nitrogen balance,[21] but it also eliminates the strain of getting on the bedpan which increases the intra-abdominal pressure as much or more than the effort of getting out of bed.[22] The patient has a much more satisfactory bowel movement when using a commode than when using a bedpan. They are in a natural position instead of an unnatural position and strain on the suture line is less.

SUMMARY

Some of the most important causes of recurrence following operations for inguinal hernia have been discussed. No attempt has been made to discuss elementary surgical principles in which every experienced surgeon is so well grounded. However, successful hernia repair is the result of infinite pains and close attention to every detail of the operation as well as the postoperative care.

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AMPUTATION OF LOWER EXTREMITIES IN THE AGED*

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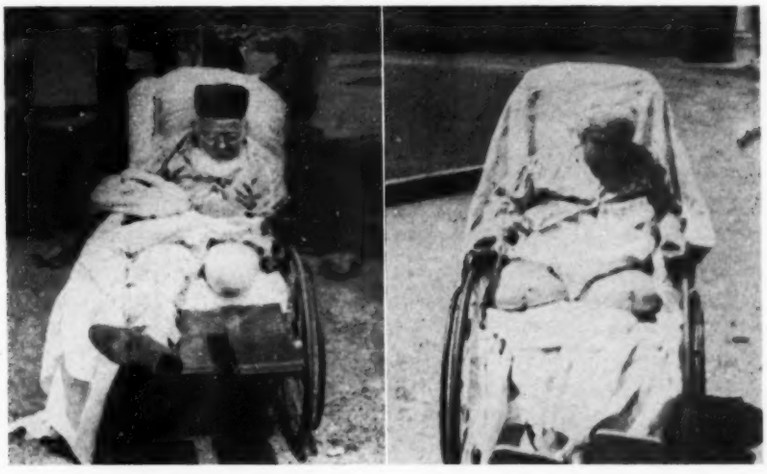
IN recent years marked progress has been made in the treatment of diseases affecting the venous circulatory system: the resection and injection treatment of varicose veins, interruption of major veins for thromboembolism and administration of heparin and dicumarol, splenorenal anastomosis and portacaval shunts for portal hypertension. The treatment of disease of the peripheral arterial system on the other hand has not given the same satisfactory results, particularly in the aged arteriosclerotic group when pain and gangrene are the cardinal symptoms. In the vast majority of cases neither lumbar sympathectomy nor the more conservative measures employing active and passive hyperemia alter the course of the disease and one is usually forced in the final analysis to perform a major amputation.



1A 1B

FIG. 1. A and B, Two of the oldest patients in this series; their exact age was unknown but estimated to be between eighty-five and ninety years. Both had low thigh amputations for arteriosclerotic gangrene; bilateral in the case of the woman.

During the ten years from 1938 to 1948 the writer or members of the house staff under his supervision performed seventy-four major amputations to the lower extremities for gangrene in seventy-two cases. Six of these patients were eighty plus years of age, twenty were seventy plus, twenty were sixty plus and nineteen were under sixty years. The average age was sixty-five years. There were twenty-six cases of arteriosclerotic gangrene; twenty-three patients had amputations above the knee and three through the leg. Four deaths occurred from cardiac failure days or weeks postoperatively, a mortality rate of 15.4 per cent. (Fig. 1.)

There were forty cases of diabetic arteriosclerotic gangrene. Five patients had lumbar ganglionectomy before amputation; thirty-three had thigh amputations and seven had leg amputations. Three individuals died, one from pneumonia and two from cardiac failure, for a mortality of 7.5 per cent. There were eight cases of embolic gangrene, two femoral, six popliteal. Seven amputations were performed through the thigh and one just below the hip joint. Two patients died of cardiac failure, giving a mortality of 25 per cent. (Table 1.)

In recent years the pendulum has swung to conservatism in the surgical treatment of dia-

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betic gangrene. Penicillin primarily and lumbar ganglionectomy secondarily are mainly responsible for the good results obtained by conservative amputations through the foot in those cases in which the vascular tree has not been too severely damaged. Many of these patients were formerly subjected to thigh or leg amputations mainly because of the surgeon's inability to control the infection and the mortality was extremely high. (According to Silbert, who collected published reports on thigh amputations in diabetics from several of the larger hospitals in the New York area, there were 300 deaths in 637 cases, a 47 per cent mortality.)

TABLE 1

Type of Gangrene	No. of Cases	Level of Amputation		Infection of Stump	Deaths	Mortality (Per cent)
		Thigh	Leg			
Arteriosclerotic	26	23	3	3	4 (cardiac)	15.4
		Thigh	Leg			
Diabetic arteriosclerotic	40	33	7	5	3 (2 cardiac, 1 pneumonia)	7.5
Embolic	8	Thigh	..	2	2 (cardiac failure)	25
		Thigh	Leg			
Total	74	64	10	10	9	12.1

Surgical Management of Gangrene Associated with Arteriolar Disease and Diabetes. Group I: In this group of individuals gangrene develops much earlier in life than in the non-diabetic group because of the intimate relationship between diabetes and arteriosclerosis. However, fortunately for many of these individuals, the sclerosis primarily attacks the arterioles and it is not uncommon to see gangrene of a toe in the presence of good dorsalis pedis and posterior tibial pulsations and normal skin temperatures. Gangrene is usually precipitated by the ill advised minor surgery of the toes followed with a low grade infection and thrombosis of the terminal arterioles. Pain is usually absent and practically never severe. If the infection can be controlled, and it usually can, we believe it is best to temporize with these individuals and either let these toes amputate themselves or by very simple, gentle surgery remove the gangrenous tissue when demarcation has been firmly established.

Group II: There is another larger group of older patients who present a more serious problem. The vascular tree is more seriously damaged and the pulsations in the major arteries have become obliterated. In those cases infection when present often cannot be controlled (nor can the blood sugar). The infection involves the fascia and tendons on the plantar surface of the foot and gangrene becomes progressive. When once it has spread beyond the web of the toes, conservative surgery is rarely successful. This is particularly true if pain is a cardinal symptom as pain indicates a severe nerve ischemia. Control of the infection and removal of the necrotic tissue do not influence the severity of the pain. We believe that in these cases reasonably prompt removal of the lower extremity above or below the knee (depending upon a number of factors to be enumerated later) is indicated. Frequently one is influenced to delay the major amputation and do a local excision of the gangrenous toe or part of the foot with disastrous results.

Surgical Management of Gangrene Not Associated with Diabetes. This group includes the next greatest number of individuals and presents the most serious problem. The age is from sixty plus years. These patients are generally poor surgical risks; their present illness is usually complicated by hypertension, myocardial degeneration and renal insufficiency. They seek surgery only after suffering severe pain for long periods of time and as a result become debilitated. Their families "would rather see them dead than lose a leg." In this type of case we never consider a foot amputation but after evaluating their general physical condition and economic status recommend an amputation above or below the knee.

Surgical Management of Gangrene Due to Sudden Arterial Occlusion. When gangrene of an extremity develops as a result of sudden

arterial occlusion due to a thrombotic or embolic process, the prognosis as to life is always grave. Simple arterial thrombosis developing in the arteries of the extremities during the course of infectious diseases or congestive heart failure is usually a sign of failing circulation and thrombosis in the cerebral or coronary arteries or pulmonary embolism frequently follows.

The heart is the chief source of emboli and the embolus is most commonly a detached thrombus or portion of a thrombus which develops in a fibrillating auricle. Early amputation is never indicated in this type of gangrene and attention should be primarily directed to cardiac treatment.

Demarcation between viable and dead tissue takes considerable time to develop. If a hasty amputation is performed just proximal to what initially seems to be the line of demarcation, the stump will invariably slough and reamputation will have to be performed at a later date if the patient survives.

One should delay the amputation for two or three weeks if there is no contraindication such as infection. During this period collateral circulation will develop and one will have the opportunity to observe whether the thrombosis is going to extend in a retrograde direction necessitating a higher amputation.

PREOPERATIVE PREPARATION FOR AMPUTATION

Attention is first directed toward the relief of pain. Opium derivatives and barbiturates are poorly tolerated by these elderly individuals; they become confused and disorientated. The renal output is diminished and feeding becomes a problem. During the past five years we have routinely used reduced temperature either by numerous ice bags or cracked ice applied continuously and directly to the leg below the knee. In every case the patient became perfectly comfortable and slept well, and appetite returned.

Complete bed rest which is so often ordered is perhaps one of the most ill advised ways to treat these cases. The impaired circulation becomes more feeble and thromboembolism and decubitus ulcers are invited. When possible these patients should be kept out of bed during the day and encouraged to move the extremities frequently if walking is not possible. Bathroom privileges are granted.

General treatment by an internist is of the greatest importance, special attention being directed to the control of diabetes if present and to the cardiorenal system. In the presence of mounting urea operation is always delayed.

We believe the sulfa drugs are contraindicated in this group of individuals because of the possibility of kidney damage and obstruction. Since the time antibiotics have been available, we have routinely used them pre- and postoperatively.

Enthusiastic reports on the intra-arterial administration of penicillin have appeared in the literature. In 1945 Glasser et al. reported twenty-four cases of severe infection of the extremities in which penicillin was administered by the intra-arterial route and claimed excellent results in all cases. Sixteen of these patients had diabetic arteriosclerotic gangrene of the extremities and infection. In some cases 50,000 units of penicillin were administered daily or every other day for three or four days and in one case a single injection was sufficient to control infection. They recommended application of a blood pressure cuff to the extremity proximal to the infection and immediate insufflation of the cuff to 280 to 300 mm. Hg and maintaining this pressure for ten minutes following injection.

Shaffer in 1946 reported eight cases of diabetic arteriosclerotic gangrene treated with intra-arterial penicillin and obtained excellent results in all cases. He claims that intra-arterial penicillin is the most effective means of limiting infection in diabetic arteriosclerotic gangrene "and will, of course, do the most for patients who have an adequate circulation." He supplemented the technic of Glasser et al. by first giving a vasodilator (papaverine hydrochloride, 1 gr.) and hot potassium permanganate soaks to the leg twenty minutes prior to injection to prevent any vasospasm that might result from puncture of the artery. He further modified their technic by raising the blood pressure in the cuff to only 60 to 80 mm. Hg (sub-diastolic level).

It is our belief that repeated puncture of a sclerotic artery is not without danger of causing thrombosis. Furthermore, the application of a tourniquet to an infected, blood-impoverished extremity for ten minutes, even if the pressure exerted is subdiastolic, is contraindicated. If a higher concentration of penicillin is indicated in a particular area, one may give

larger intramuscular injections and obtain the desired result.

"In case of threatened loss of a leg the lumbar sympathectomy is of doubtful value. If pain plus gangrene, for which amputation is usually performed, is not relieved by other means lumbar sympathetic resection is also likely to fail."[5]

Our experience bears out this observation for in no instance[7] were we able to save a limb by performing a sympathectomy when severe pain and gangrene were present. We are confident on the other hand that we have been able to perform successful amputations through the leg or foot because a sympathectomy had been performed.

De Takats, Gemerin and others report good results following sympathectomy in arteriosclerotic gangrene. However, in nearly all their successful cases the gangrene was limited to the toes and pain was not a dominant feature.

Whether to amputate above or below the knee is a question that must be decided in each individual case after many factors are taken into consideration. One can generally be certain of healing if the amputation is performed above the knee. If the amputation is performed below the knee, the risk of infection is greater and non-healing frequently occurs necessitating a secondary operation or reamputation. However, Silbert recently reported 127 cases of extensive gangrene with or without infection in diabetic patients all of whom had advanced impairment of circulation. Treatment was by mid-leg amputation. A guillotine type of operation was performed leaving the stump wide open and healing occurred in ten to twelve weeks. The mortality was 9.4 per cent. He believes the mortality would have been much higher had the amputations been performed through the thigh. McKittrick also reports a very low mortality (4.1 per cent in 169 cases) in amputations through the leg in diabetics.

No one will deny the great advantages of a leg amputation as compared to one in the thigh if the patient can wear a prosthesis but it is our belief that the low mortality rate was not due to the lower level of amputation but to the fact that a guillotine amputation was performed. The long hospitalization and aftercare (ten to twelve weeks) offer serious objections to the guillotine operation as a routine procedure. If the patient is advanced in years, he will have much more trouble wearing a prosthesis below the knee than above.

In general we think an amputation below the knee is indicated if the following conditions are present: (1) a good popliteal pulse, (2) absence of infection in the foot of the limb to be amputated, (3) if the patient will be able to use a prosthesis. If, however, the patient is an active individual, has previously had a thigh amputated and does not have a popliteal pulse, we think an amputation should be attempted below the knee.

Although not ideal, a satisfactory prosthesis can be fitted to a leg stump of 7 cm. If an individual in the aged group has a bilateral thigh amputation, his chances for unassisted ambulation are very poor; but with a prosthesis for a thigh and leg stump he is at least able to walk with arm crutches.

The day before operation the leg and thigh are shaved and washed with green soap and water. This is followed with applications of ether, alcohol and zephiran. The leg and thigh are then wrapped in sterile towels which are not removed until the patient is placed upon the operating table. After the towels have been removed, the leg is supported by an assistant holding the foot. The thigh and leg are again painted with zephiran which is removed with alcohol and a final coat of zephiran is applied and left on. A heavy sterile sheet is placed under the extremity while it is still supported and a pillow case is spread under the leg which is then lowered. The leg is then wrapped up to or below the knee and over this a sterile gauze roll is applied. A folded towel is rolled about the thigh just above the proposed site of amputation. A split sheet is then used for draping the upper part of the thigh and the trunk.

From the standpoint of the anesthesiologist these patients present a serious problem. They all have arteriosclerotic cardiovascular disease frequently associated with hypertension. Routine electrocardiographic studies reveal a very high incidence of coronary artery disease. Many of these people also have diabetes which is difficult to control in the presence of the existing infection and gangrene.

Therefore, we have used anesthetic agents and technics which we deemed best suited for these poor risk cases.

The majority are induced with sodium pentothal® (2 per cent) and first place surgical anesthesia maintained with a mixture of nitrous

oxide and oxygen, either 50–50 per cent or 60–40 per cent. Small amounts of the pentothal solution are added from time to time if additional pentothal is warranted. Should this combination of pentothal-nitrous oxide-oxygen prove inadequate, small amounts of cyclopropane are added.

We do not try to force the anesthesia by using large quantities of sodium pentothal, 500 mg. of sodium pentothal is the maximum allowed for any individual. Furthermore, we want these individuals to be awake as soon as possible and thus diminish the likelihood of postoperative pulmonary and cardiac complications. Neither do we increase the concentration of nitrous oxide because of the danger of hypoxia in these patients in whom the cardiac and pulmonary reserve is frequently so low.

Our results with this balanced type of anesthesia have been very good. Practically all the patients are awake either at the end of surgery or by the time they return to their room and thus far there have not been any postoperative anesthetic complications of a serious nature. One must also bear in mind that the agents used will disturb the blood sugar in patients with diabetes much less than will ethyl ether.

In this series was a certain group of patients who had a history of cardiac decompensation or were debilitated and cachetic and we thought these patients would do better under regional anesthesia. Therefore, from 5 to 7 mg. of pontocaine hydrochloride to which had been added 1 cc of 10 per cent glucose were given through the third lumbar interspace with the patient in the lateral position, the affected leg down. The patient was kept in this position for several minutes in an effort to have the hyperboric solution anesthetize only the leg to be amputated. This technic was usually effective as evidenced by the minimal amount of anesthesia observed in the other extremity. When hypotension developed, two minims of neosynephrin hydrochloride were given intramuscularly.

Fluids are started at the beginning of the case or in the patient's room prior to surgery and are run slowly. Saline solutions are avoided in the hypertensive patient, and in the diabetic patient insulin is administered to cover the excess glucose. Each patient is typed and cross matched and blood made available in the blood bank should transfusion be necessary. However, transfusion has rarely been needed because of careful hemostasis during surgery.

From our own experience and that of others intravenous procaine has proven beneficial in maintaining normal heart rate and rhythm in cardiac patients and, therefore, of late we have been adding 1 gm. procaine to the liter of fluids being received by the patient.

TECHNIC OF LOW THIGH AMPUTATION

We have routinely used the following technic which is familiar to all surgeons but we wish to emphasize certain points that we believe make for primary healing and clean wounds. Tourniquets are never used.

The knee is slightly flexed and with a 5 per cent solution of brilliant green a long anterior and a short posterior flap of skin are outlined. The anterior flap has its apex over the upper margin of the patella and its base from the middle part of the femur on the outer to the middle point on the inner side. The length of the anterior flap should be such that it can easily swing to the posterior surface of the leg. The posterior skin flap is outlined by joining the two points on the femur in a slightly convex manner. The point of a hypodermic needle is then dipped in brilliant green and by piercing the skin and quadriceps femoris tendon the middle point is marked. In the same manner the saw line on the bone is marked off at the middle point of the base of the anterior flap. (Those patients who have had pain for a long time assume a characteristic position in bed with the leg externally rotated and flexed at the knee and hip. The skin and muscles become very much contracted and the flaps must be made generously long as marked retraction occurs when they are cut.)

The anterior skin flap is then incised to the fascia and allowed to retract but not dissected off the underlying muscles. It is important to find and tie the internal saphenous vein.

Following the retracted skin edge the muscles are incised down to the femur and close to the patella. This flap consists principally of quadriceps femoris tendon with a small portion of adjoining musculature. The quadriceps bursa is excised.

The leg is then flexed at the knee and with a scissors the intermuscular system is pierced on the medial side and with a curved clamp or the index finger the femoral artery and vein are elevated, clamped, severed and tied. The leg is then elevated. In raising the posterior skin flap great care must be exercised lest the

posterior fascia is cut. The skin incision is outlined with a scalpel and then beginning on one side the skin is dissected off the fascia with a scissors. The distal margins of the skin are grasped with Ochsner clamps and the fascia is exposed distally for 6 or 7 cm. A guide suture is then anchored in the midline of the fascia. The posterior fascia and muscles are then cut in a bold convex sweep at a much lower level than the skin as these tissues retract markedly. The bone is denuded of periosteum at the point designated by the brilliant green and sawed at this point. After rounding the edges with a rasp the bone filings are washed away with normal salt solution and ether.

The sciatic nerve is transfixed at a high level, cut and allowed to retract. Formerly we injected the nerve with 95 per cent alcohol. This procedure has been abandoned since we had the opportunity of examining several stumps where the nerve had been so treated. There was a marked inflammatory reaction in the soft tissues surrounding the nerve and local accumulation of fluid which we think is conducive to infection.

Meticulous care must be paid to hemastasis for in no other operative procedure is a dry wound more essential to primary healing.

The stump is now flexed on the thigh at about an angle of 30 degrees to determine whether the fashioned flaps of skin and muscle will fit over the bone end without tension. If the flaps cannot be easily coaptated, more bone should be removed. We are convinced that almost every case of infection in the stump was to some extent the result of tension on the flaps.

Silk or cotton is routinely used for ligature of vessels and coaptation of the muscle and skin flaps in the absence of infection in the leg. They are well tolerated by these soft tissues that are so deficient in blood supply. When infection is present in the foot, we use catgut since infection in the stump, if it does occur, will clear up more promptly.

Closure of the stump is greatly facilitated by the guide suture placed in the deep fascia posteriorly and by the brilliant green mark in the quadriceps tendon anteriorly. After coaptating these two points, which brings the tendon directly over the bone end, interrupted sutures are contrived to join the tendon and its lateral expansions to the posterior deep fascia. The skin flaps are also sutured in the same manner. Drainage is not used.

SUMMARY

1. Seventy-four cases of major amputations for gangrene and pain through the lower extremities are presented.

2. Sixty-four had thigh amputations and ten through some level of the leg.

3. In ten cases wound infections developed. Eight of the ten infections were minor and two were severe.

4. There were nine deaths, eight from cardiac failure and one from pneumonia.

5. In the aged arteriosclerotic group the mortality was 15.4 per cent, in the diabetic group 7.5 per cent and in the embolic group 25 per cent.

6. In our experience lumbar ganglionectomy will not alter the course of the disease when the vascular tree is severely damaged.

7. A detailed description of the pre- and postoperative preparation and technic for low thigh amputation is given.

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Obstetric Clinic

THE woman about to become a mother or with a new-born infant upon her bosom, should be the object of trembling care and sympathy wherever she bears her tender burden, or stretches her aching limbs. The very outcast of the streets has pity upon her sister in degradation, when the seal of promised maternity is impressed upon her. The remorseless vengeance of the law brought down upon its victims by a machinery as sure as destiny, is arrested in its fall at a word which reveals her transient claim for mercy. The solemn prayer of the liturgy singles out her sorrows from the multiplied trials of life, to plead for her in her hour of peril. God forbid that any member of the profession to which she trusts her life, doubly precious at that eventful period, should hazard it negligently, unadvisedly or selfishly.

OLIVER WENDELL HOLMES

7th of the Series

ECTOPIC PREGNANCY*

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DEATH from ectopic pregnancy still occurs. Knowledge of the controllable factors should aid in further reducing this mortality.

* * * *

CASE I. A thirty-four year old white primigravida who had skipped a menstrual period noted vaginal bleeding and spotting during the following month. She then experienced severe abdominal pain and called her physician who gave her an injection and advised bed rest. Seven hours later she became cold and had pain in the right shoulder. She was then advised to enter the hospital. On admission she was in deep shock with no pulse or blood pressure discernible. She was cyanotic, pale and had shallow respirations. Death occurred thirty-five minutes later, before any blood transfusion could be given.

Autopsy showed a ruptured right tubal pregnancy and massive hematoperitoneum.

CASE II. This patient was a thirty year old Negro, gravida II, para I, who after amenorrhea of two months had slight vaginal bleeding. Fifteen hours prior to admission to the hospital she suffered a sharp pain in the lower abdomen and fainted.

Examination showed profound shock. The abdomen was rigid, tender and slightly distended. Motion of the cervix produced great pain and there was fullness in the posterior cul-de-sac. A diagnosis of ruptured ectopic pregnancy was made and preparations for immediate transfusion and operation carried out. Laparotomy was begun two hours after admission, with blood transfusions running into the right arm and foot. The patient was still pulseless and without obtainable blood pressure. There was no bleeding when the skin was incised. The abdomen was full of blood and the right tube was ruptured. Rapid salpingectomy was performed but the patient stopped breathing twenty-five minutes after the start of the

*Cases are from the Committee on Maternal Welfare of the Medical Society of the County of Kings, Brooklyn, N. Y. The views expressed are those of the authors.

operation, as the third through and through closing suture was being placed. She had received 1,500 cc. of blood by transfusion.

Questions. (1) What is the incidence of ectopic pregnancy? In what age group does it most frequently occur? (2) How serious is this condition? What is its mortality rate? (3) What part does death from ectopic pregnancy play in regard to total puerperal mortality? (4) What controllable factor was responsible for the death of these two patients?

Answers. Ectopic pregnancy is relatively infrequent. In hospital practice it occurs about once in two hundred admissions for pregnancy or fifty admissions for gynecologic disorders. It is encountered more frequently in urban than in rural areas perhaps because of the greater incidence of pelvic infection in cities. However, the general practitioner meets with this condition much less often than pelvic infection and abortion, for which it is commonly mistaken, and this partly accounts for failure of diagnosis. The greatest number of cases occur in the age group twenty-five to thirty-five years.

Ectopic pregnancy is a serious complication of pregnancy. It is a surgical emergency in which delay in diagnosis and treatment contributes heavily to death.

In tubal pregnancy the severity of the symptoms depends upon the site of the pregnancy as ampullar, isthmic or interstitial. The nearer the site of implantation is to the uterus, the more serious and sudden the effects. Fortunately the frequency of the three sites favors the less dangerous forms, but all three occur.

Large series of cases have been published in which the mortality rate is from 4 to 8 per cent. Deaths from ectopic gestation consistently form about 6 to 8 per cent of the total puerperal mortality in certain large cities.

Despite all advances in therapy, deaths still occur and these often can be ascribed to failure or delay in diagnosis. Obviously this is the controllable factor in the two cases just cited. The vigorous treatment given to the second patient after hospital admission failed because the long delay of fifteen hours after rupture permitted massive internal hemorrhage and irreversible shock to occur.

* * * *

CASE III. This patient was an eighteen year old white single female who was admitted to the surgical service of the hospital. Her past medical history was essentially irrelevant. Menses occurred every twenty-eight days and lasted three days. She admitted coitus for the past seven months. Although no mention was made in the original history of the time of her last menses, there was probably some period of amenorrhea during which time the patient considered herself pregnant. A friend stated that the patient had introduced some tablets into the vagina for the purpose of inducing an abortion. On admission her complaints consisted of vaginal bleeding for two weeks, dysuria for ten days and pains in the right lower abdomen, often sharp in character, together with chills and fever for six days.

On examination the temperature was 99.8°F., pulse 110 and respirations 24. The patient appeared acutely ill. The abdomen was very tender and resistant in the lower quadrants, more marked on the right than on the left. On vaginal examination a large, tender mass was felt on the right, displacing the uterus to the left. The hemoglobin was 35 gm. per cent with 1,600,000 erythrocytes and the white blood cell count was 34,000 with 34 per cent polymorphonuclear cells. The sedimentation rate was 18 mm. for one hour. A diagnosis of acute pelvic inflammatory disease was made.

She was, however, examined by a gynecologist on the following day. He found the abdomen moderately distended throughout its lower portion and there was some rebound pain. No pus could be expressed from Skene's or Bartholin's ducts. The cervix was closed and softened. The uterus appeared to be uniformly enlarged to the size of a three months' pregnancy, softened and tender. There was considerable tenderness in both lateral fornices, more marked on the right, but no masses could be found. A diagnosis of intrauterine pregnancy with associated salpingo-oophoritis or pelvic peritonitis due to septic abortion was made.

The patient was accepted for transfer to the gynecologic service and later examined by another member of the staff who noted a fluid wave and dullness in the flanks. The diagnosis made previously was not changed. The patient's condition was very poor at this time; and while blood was being taken from a donor for the purpose of transfusion, she expired. Autopsy showed her abdomen filled with about 2,000 cc. of fluid and clotted blood. The uterus was about normal size. The right tube showed a bulbar swelling in the proximal portion. Part

of the tube in the isthmic region on this side was entirely torn away.

Questions. (1) In general, how difficult is the diagnosis of ectopic pregnancy? (2) Of what value is the history? Does the presence of etiologic factors aid in the diagnosis? (3) In this case an examiner felt the uterus to be enlarged to that of a three months' pregnancy and yet on autopsy it was seen to be of about normal size. How can one account for this? (4) Were the findings of a fluid wave and dullness in the flanks important?

Answers. In general the diagnosis of ectopic pregnancy is not difficult if the examiner is ectopic minded and willing to take sufficient time for a detailed history with painstaking, methodical search for symptoms and physical signs due to the escape of blood into the peritoneal cavity or lumen of the tube. Correct diagnoses are the rule when amenorrhea and vaginal spotting are followed with severe lower abdominal pain and shock. However, the great frequency of atypical cases, in which the internal blood loss is slower and smaller, accounts for the fact that ectopic pregnancy is probably the most commonly misdiagnosed of all the pathologic conditions arising in the female pelvis.

Unfortunately, too, the patient is often at fault for not presenting herself for immediate examination when slight abdominal pain and vaginal spotting follow amenorrhea during the reproductive period of life. Although many of these patients consider themselves to be pregnant, these symptoms are often regarded lightly and consultation is postponed. The possibility of ectopic pregnancy is one of the most important reasons for early prenatal care and an initial pelvic examination. When such a patient does present herself, ectopic pregnancy should always be ruled out before the more probable diagnosis of threatened abortion is entertained. To think of ectopic pregnancy is often all that is necessary to make the diagnosis.

The history is of the utmost importance. In fact, we consider it to be of greater value than physical examination, laboratory aids or special diagnostic procedures. Certain questions should be asked. What was the patient doing when pain occurred, where was the pain and did it radiate to the shoulder? Did she feel nauseous or vomit afterward? Did she faint or feel a sinking sensation in the epigastrium with giddiness and a tendency to fall? Did she notice painful urination or defecation afterward? Has vaginal spotting occurred? Although the symptoms are often characteristic, they may be fleeting. Careful inquiry is essential. The symptom of faintness or even slight syncope is especially valuable.

In the unmarried and when attempts at criminal abortion have been made as in this case, the history may be falsified. In such cases objective findings assume increased importance in making the diagnosis. The fluid wave and dullness in the flanks discounted by a careful observer in this case were diagnostic.

Low fertility, previous laparotomy, pelvic infection and multiparity with repeated abortions are predisposing causes for ectopic pregnancy, yet previous pelvic infection may suggest acute exacerbation of chronic salpingo-oophoritis rather than ectopic pregnancy. A history of previous ectopic pregnancy, however, is significant, for repetition occurs in about 4 per cent of cases.

In regard to the discrepancy in the size of the uterus noted at autopsy as compared with pelvic examination it must be recognized that pelvic examination after rupture of a tubal pregnancy is often exceedingly painful. The patient may make attempts at identification difficult. Adherent blood clots to the uterus may also tend to exaggerate its size.

* * * *

Case IV. The patient was a thirty-seven year old white gravida III, para II. Her menstrual periods had always been regular until two months prior to hospital admission. Four weeks before admission she began to bleed vaginally and this continued for four days. She consulted her doctor because of a bearing-down sensation in both lower quadrants of the abdomen. An ovarian cyst was diagnosed. On the evening of admission the patient was seized with severe abdominal pain and diarrhea and fainted three times.

Examination showed all the signs of shock. Her blood pressure was 70/50. The hemoglobin was 56 gm. per cent and the red blood cell count 3,000,000. There was marked rebound pain and a definite fluid wave was demonstrated in the abdomen.

A diagnosis of ruptured ectopic pregnancy was made and immediate laparotomy was performed under spinal anesthesia. The peritoneal

cavity contained about 2,000 cc. of blood which was mostly clotted. The left tube was distended in the middle third and ruptured. There was hydrosalpinx of the right tube. A left salpingectomy was performed and the large clots were removed.

When the patient was returned to her bed, her pulse was still thready and rapid. An intravenous infusion of glucose solution was begun after cutting down on the vein. A few minutes later blood was substituted for the glucose solution. While the transfusion was in operation, the patient stopped breathing. There was no record of the amount of blood infused. She was pronounced dead after a total stay in the hospital of about two and one-half hours.

Questions. (1) Is amenorrhea an essential symptom of ectopic pregnancy? (2) What type of vaginal bleeding is seen? What is its source? (3) Was spinal a good choice of anesthesia?

Answers. A delayed or missed menstrual period is a characteristic symptom of ectopic pregnancy. However, in about one-third of cases vaginal bleeding occurs at the expected time of menses and occasionally even a little before, and this is often interpreted by the patient as a menstrual period. In this case vaginal bleeding actually did occur at the time of expected menses but apparently differed sufficiently in character to be recognized as abnormal vaginal bleeding. In eliciting the history of last menses great care must be taken not to be misled by the patient but to inquire as to whether it was normal in time, duration, amount and character.

The vaginal bleeding in ectopic pregnancy results from the breaking down and shedding of the decidua. It occurs in about three-fourths of cases and is frequently the first symptom noted by the patient. In tubal pregnancy implantation takes place in poor soil and early death of the ovum or embryo occurs. The resultant hormonal changes cause decidual degeneration and shedding. This generally occurs on or before the sixth week of gestation. Since the hemorrhagic discharge includes the secretion of uterine glands as well as bits of degenerated tissue, it generally does not clot. Chocolate-colored vaginal bleeding or spotting is regarded as a characteristic and valuable sign. Once it starts it continues, although occasionally with interruption. In some cases the patient may not be aware of a hemorrhagic vaginal discharge that is first noted by the examining physician. Not infrequently the vaginal bleeding may be excessive enough to suggest abortion of an intrauterine pregnancy.

Spinal anesthesia adds greatly to the syndrome of shock from hemorrhage. It causes generalized vasodilation with pooling of blood in the viscera and lower extremities thus reducing the circulating blood volume still further. Finally, there is diminished cardiac output with reduction in cerebral circulation and failure of the respiratory and vasomotor centers. This patient should have had her blood volume restored promptly by transfusion and been given an anesthetic which maintains cardiac output and allows maximum cerebral circulation. General anesthesia that includes a high percentage of oxygen is preferred.

* * * *

CASE V. The patient was a thirty-eight year old white primigravida who was brought to the hospital by ambulance. Her major complaints were lower abdominal pain, vomiting and constipation of four days' duration following amenorrhea of two months. Her family physician believed she had partial intestinal obstruction. Two weeks previously, after she had lifted a 75 pound piece of ice, she experienced sudden, acute pain in the left lower quadrant. The pain persisted for about one week, decreasing in severity. For the remaining week before admission to the hospital the pain was attributed to obstipation.

On admission to the hospital the patient's temperature was 99.4°F., pulse 104, respirations 24 and blood pressure 90/60. General examination was negative except for extreme obesity, marked abdominal distention and moderate generalized pallor. Admission blood counts showed a hemoglobin of 35 gm. per cent, 1,680,000 red blood cells and 21,280 white blood cells. Pelvic examination revealed the characteristic findings of early pregnancy with fullness and tenderness in the left fornix. When she was operated upon six hours after admission, she was found to have a rupture of a left tubal pregnancy. A transfusion of 600 cc. of blood was started at the beginning of the operation. She died six hours later.

At autopsy a considerable amount of blood was found in the abdominal cavity but no more than was estimated to have been left at the time of operation.

CASE VI. This patient was a thirty-nine year old white female who was admitted to the surgical service of a hospital complaining of abdominal pain of only mild severity and large painful hemorrhoids. Abdominal discomfort began about three months previously. At this time, following an amenorrhea of one month, the patient complained of mild lower abdominal pain and morning nausea. At the time of her next expected menses she spotted slightly. The following menstrual date was marked by no bleeding whatever.

She was generally comfortable, with a temperature of 99°F., pulse 88 and respirations 20. In an attempt to establish a diagnosis a proctoscopic examination was made but no gross pathologic condition was disclosed. A flat plate of the abdomen followed with a barium enema also revealed no pathologic condition of consequence. The patient remained fairly comfortable, being up and about in a wheelchair for her first few days of hospitalization while the aforementioned diagnostic procedures were being performed.

One week after admission, following a low cleansing enema, the patient was found in the bathroom in a state of severe shock and complaining of intense lower abdominal pain and weakness. The blood pressure at that time was 60/40 and the pulse rate 120 per minute. Shock therapy was instituted, including the administration of 500 cc. of plasma. The patient rallied somewhat, and when seen by a gynecologic consultant, her condition was good enough to withstand laparotomy for ruptured ectopic gestation. On opening the abdominal cavity approximately 2,000 cc. of free blood were encountered. Her left tube was almost unidentifiable because of infiltration by placental tissue of its entire extent. It appeared to have burst in its middle third. A large, irregular mass of placental tissue was found adherent to the sigmoid, uterus, omentum and loops of jejunum. Proceeding from this mass an umbilical cord was found to connect with a dead fetus of approximately three months' size lying in the cul-de-sac. A left salpingo-oophorectomy was performed, with the removal of all separable placental tissue. The patient tolerated the operation fairly well, receiving blood and plasma in adequate amounts.

The first five postoperative days were not unduly stormy. The temperature range was from 100° to 102°F., pulse 100 to 120 and respiratory rate 20 to 24. Abdominal distention was troublesome and was controlled with the use of the Wangensteen apparatus. Suddenly, on the sixth postoperative day, the patient became markedly cyanotic and expired within ten minutes. Death was attributed to pulmonary embolism.

Questions. (1) How frequently is pain complained of in ectopic pregnancy? What is its character and site? (2) What is the pathogenesis of tubal rupture? Is exertion a factor? (3) Did these patients receive sufficient blood transfusion?

Answers. Practically all patients complain of pain at some time or other. It is the most frequent and reliable symptom but may vary greatly in character, intensity and site. At first it may be mild and colicky in nature, resembling gas pains. Occasionally it may be present perhaps only for a day but in most cases it is recurrent and may settle down to be a continuous or dragging ache. The association of recurrent attacks of pain and vaginal bleeding is most important. When tubal rupture or abortion occurs, the pain generally becomes sharp and cutting and may be followed with nausea, vomiting and fainting.

The site of the pain is generally the lower abdomen. It may be present all over the lower abdomen or limited to the iliac fossa on the affected side. Unusual and misleading sites for pain may be noted such as the epigastrium, sacrum or anus. Pain on defecation or urination and, in particular, shoulder pain are most significant. Painful defecation may first call attention to the diagnosis. Pelvic inflammatory disease will rarely cause this symptom unless pelvic abscess is present. Hematoperitoneum may cause the pain to vary in site from the anus to the shoulders. Thus the precise location of pain is of little importance.

Tubal rupture generally occurs spontaneously as the result of erosion by trophoblastic cells. A thinned-out tubal wall may rupture at the time of exertion, as noted in Case v after the patient lifted a heavy piece of ice. Rupture after defecation with the finding of the patient in collapse in the bathroom is not unusual. Coitus and, in particular, rough or even repeated gentle bimanual examinations may also cause rupture. A catastrophic rupture may have been preceded by smaller repeated ruptures.

The two patients in the aforementioned case reports received inadequate blood transfusions. In Case v 600 cc. of blood were given after an internal hemorrhage severe enough to reduce the hemoglobin to 35 gm. per cent and the red blood cell count to 1,680,000. In Case vi only plasma was given.

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Case vii. The patient was a twenty-nine year old white female, gravida iii, para ii. Her history included irregular menstrual periods, varying from a 5- to 7-week interval. A urine pregnancy test after amenorrhea of eight weeks was positive. On the following day the patient complained of pain in the right lower quadrant of her abdomen and dizziness. She had, however, no bleeding or vomiting. With rest, ice bag and sedatives the pain subsided so that she was allowed out of bed at home and was up and about. She continued in this fashion for about four days. This treatment at home was apparently followed as a result of consultation with a doctor.

On the morning of admission to the hospital the patient was suddenly seized with severe pain in the lower abdomen and fainted. When admitted she was seen to be in shock; the pulse was 140, the blood pressure 90/40 and the skin cold and clammy. The abdomen was tender, particularly over the right lower quadrant. On pelvic examination there was no bleeding and the cervical os was closed. There was exquisite pain on motion of the cervix. The uterus seemed to be small and regular in outline. There was tenderness in the region of the left fornix. The right fornix contained a tender, cystic mass about the size of a lemon. The cul-de-sac was not bulging.

A diagnosis of ectopic pregnancy was made. Intravenous glucose solution was started promptly on admission. Morphine sulfate, ¼ gr., was also given. Typing, matching and cross matching were done while preparations were made for the laparotomy.

At operation about 1,200 cc. of free and clotted blood were found in the abdominal cavity. The right tube was ruptured along its upper border with an eight weeks' pregnancy *in situ* and intact in the sac. The right ovary, tube and sac were removed as well as large clots. The patient seemed somewhat improved after the operation. Postoperatively 700 cc. of citrated blood replaced the glucose solution. When about 100 cc. had been introduced, the patient was noted to be cyanotic, her pulse was imperceptible and respirations became labored with a decided expiratory wheeze. Blood transfusion was stopped and replaced with glucose solution. A recheck of the blood showed no error in typing or cross matching.

The patient remained in profound shock in spite of morphine, adrenalin, coramine and oxygen and expired six hours after admission. She obviously needed more blood but it was believed that this secondary reaction may have been due to the transfusion and for this reason more blood was withheld.

Questions. (1) What are the physical findings in ectopic pregnancy? (2) Is the urine pregnancy test of value in the diagnosis? (3) What are the factors contributing to death in this case?

Answers. When internal hemorrhage has been sudden and severe, shock follows. On abdominal examination the most constant finding is tenderness. It varies with the amount of hematosalpinx and hematoperitoneum and is generally most marked over the site of maximum pain on the affected side. Although rigidity is occasionally felt, it is rarely board-like. It is often unilateral and less marked than that seen in acute salpingitis and appendicitis. When muscle spasm is absent, the abdomen may feel doughy. More reliable as a sign of peritoneal irritation from concealed blood is rebound pain. Abdominal distention may be present as a result of hematoperitoneum and resultant partial ileus. It occurs typically below the umbilicus. Large amounts of blood may be present in the abdominal cavity and cause wide variation in physical findings; yet it may not always be recognized by the presence of a fluid wave and shifting dullness although these signs must always be carefully looked for. A lower abdominal mass is rarely found, but if found it should suggest secondary abdominal pregnancy or a large pelvic hematocele. Severe intraligamentous hemorrhage may be diagnosed by the characteristic shape of the parametrial mass and the absence of blood in the flanks.

Cullen's sign, a bluish discoloration of the skin about the umbilicus, is a textbook curiosity and is only occasionally seen. During laparotomy hematoperitoneum may first disclose itself by similar discoloration of the parietal

peritoneum before the abdominal cavity is actually opened.

On pelvic examination the slight dark brownish spotting characteristic of an ectopic pregnancy may be observed but the discharge may infrequently be redder and more profuse, and in about one-fourth of all cases hemorrhagic discharge of any type may be entirely absent. *Too vigorous attempts to delineate pelvic viscera and masses are hazardous, for rupture of a thinned-out tube may occur. This is especially true of pelvic examination under general anesthesia.* Generalized tenderness throughout the pelvis is a frequent finding. The tenderness may be so extreme as to prevent satisfactory examination. It may appear to be all out of proportion to the size of palpable masses and is greater than that felt in salpingo-oophoritis or pelvic abscess. It is generally present even when abnormal pelvic masses are absent.

The most significant and valuable finding of all is tenderness on motion of the cervix due to peritoneal irritation from blood in the pelvis. To elicit this important sign it is suggested that the finger first be gently passed over the fornices and then the cervix moved from side to side and upward. The extent of the movement need not be great. There is generally no need to ask the patient if she has pain. A sharp inspiration, stiffening of the back and bitter complaint will make it obvious. Here again we may contrast the findings with those of salpingo-oophoritis when lateral tenderness is greater than that elicited on motion of the cervix. Softening of the cervix occurs frequently. Although the uterus enlarges during the first six to eight weeks of pregnancy at about the same rate in tubal as in intrauterine pregnancy, an enlarged uterus may be difficult to palpate because of the marked pelvic tenderness. It is not a reliable sign even in the nulliparous patient.

Tender masses either lateral to the uterus or in the posterior cul-de-sac may be palpated in about one-half to two-thirds of cases and depend upon the site and age of the implanted ovum, the size of a hematosalpinx and the presence of clotted blood outside the tubal lumen. They are more frequently felt when hemorrhage from tubal rupture or abortion has not been suddenly severe. A tender cystic or doughy unilateral tubo-ovarian mass may be felt. The cul-de-sac may be filled with a fluctuant or doughy ill defined mass and pulsation may be noted in a lateral vaginal fornix. Pelvic hematocele is occasionally misinterpreted as a fibroid, ovarian cyst or pelvic abscess.

Threatened and septic abortion rank high on the list of conditions that are erroneously diagnosed in cases of ectopic gestation. Occasionally the history of the patient tends to mislead the examiner in that it includes an attempt at criminal induction of a supposed intrauterine pregnancy. Occasionally in large hospital services patients are discharged for home care with a diagnosis of threatened abortion, or after curettage for supposed incomplete abortion, only to return in shock from rupture of an undiagnosed tubal pregnancy.

The urine pregnancy test is of some value only if interpreted correctly. A positive test indicates the presence of live trophoblastic tissue and hence will not differentiate an ectopic from a disturbed intrauterine pregnancy with which it is occasionally confused. Further, a negative urine pregnancy test will not rule out ectopic pregnancy since chorionic tissue may have ceased to function. A continuing positive urine pregnancy test in tubal pregnancy occurs only in those rare instances when the pregnancy advances or secondary abdominal pregnancy occurs.

The greatest value of the urine pregnancy test, when positive, lies in differentiation of salpingo-oophoritis. A unilateral adnexal mass and a positive urine pregnancy test may be diagnostic of ectopic pregnancy. In regard to the diagnosis of intrauterine pregnancy and salpingo-oophoritis, made in Case III of this series, this combination rarely occurs despite the frequency of each condition independently. Such patients generally prove themselves to have ectopic gestation.

The controllable factors in this case were delayed diagnosis and inadequate transfusion. A complaint of unilateral pain and dizziness in early pregnancy must be regarded seriously. However, it is easy to be unduly critical of the physician who first saw her at home. We do not know whether he examined the patient vaginally or not. Certainly he should have. Since the pain subsided under conservative therapy, one might easily be misled. It would be interesting to know whether the physician considered ectopic pregnancy or not. The chances are he did not. It is a fact, however, that the first physician to see the patient should make the diagnosis if he will give the history proper weight.

In regard to inadequate blood transfusion, so much has been written and taught concerning the imperative need for large quantities of compatible blood in institutions where patients are confined that it is repetitious to comment on it again. Transfusion of whole blood should have been begun before or at least at the onset of the operation.

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CASE VIII. The patient was a thirty-one year old white gravida III, para II, who complained to her family physician of vague generalized abdominal pain on several occasions and vaginal spotting. Her last menstrual period had occurred seven weeks previously. On examination the uterus appeared to be slightly enlarged and no adnexal masses were palpable. She was next seen at home seven days later, complaining of nausea, vomiting and cramp-like abdominal pains. Examination revealed the abdomen to be distended with minimal tenderness in both lower quadrants. The patient improved by the following day and a diagnosis of threatened abortion was made. Four days later she was again seen at her home and appeared dehydrated. She had become weak on arising from bed the previous day. Hospitalization was advised because of the dehydration.

On admission to the hospital the patient's temperature was 99.8°F., hemoglobin 64 gm. per cent, red blood cells 3,100,000, leukocyte count 10,400 and the sedimentation rate slightly increased. Six hours after admission the patient was seen to be in deep shock. The abdomen was diffusely distended and it was clear that she was bleeding intra-abdominally. Restorative measures were instituted and laparotomy performed. Hematoperitoneum was encountered and a ruptured left tube was removed. On return from the operating room the blood pressure was 110/70, pulse 128 and of good quality. During and immediately following the operation the patient received 2,000 cc. of whole blood, 2,000 cc. of ⅙ molar sodium lactate, 2,000 cc. of 5 per cent glucose and one unit of plasma.

Six hours after the operation signs of pulmonary edema developed. The patient then received aminophyllin, 7½ gr., and mercuhydrin, 1 cc. in 25 cc. of 50 per cent glucose. Her pulse remained strong, varying between 120 and 130, and her blood pressure was between 120 and 140 systolic. Urinary output was adequate. Twenty-four hours later, in spite of the persistence of pulmonary edema, it was believed that the patient exhibited signs of cerebral anemia. A transfusion of 500 cc. of whole blood was begun slowly. After administration of 400 cc. the patient's condition rapidly deteriorated and she expired.

CASE IX. The patient was a thirty-seven year old white female, gravida III, para I. She had had two previous spontaneous abortions. Five weeks after her last menstrual period the patient experienced a sudden sharp pain in the lower abdomen associated with faintness and blurring of vision. A short time later she vomited. Pain persisted. An ambulance was called but the patient refused to go to the hospital as the ambulance surgeon had advised.

On the following day the ambulance was again called and this time the patient was taken to the hospital. On admission her temperature was 100°F., pulse 136, respirations 32 and blood pressure 140/80. A white blood count showed 19,500 with 86 per cent polymorphonuclears. The red blood cell count was 2,250,000 with 54 per cent hemoglobin. A blood transfusion of 500 cc. was given and laparotomy performed. At operation a ruptured left tubal pregnancy was found and the tube was removed. No attempt was made to remove all the blood from the abdominal cavity. Four hours later the patient's condition seemed to be good. Her pulse was 126 and blood pressure 130/60. Intravenous glucose solution was started and continued until death about thirty-six hours after admission. The total amount of fluid given, including blood, in this period of time was 7,000 cc. The details as to the postoperative condition prior to death were as follows:

At 2:00 A.M. a transfusion was begun and 525 cc. of blood were given. Two hours later the patient became pale and drowsy, began to sweat profusely and her blood pressure dropped to 90/55. The respirations were Cheyne-Stokes in character, with a rapid pulse of poor quality. Coramine and caffeine were given and oxygen was administered. The respirations fell to 12 per minute, due perhaps to the morphine which was given. The red blood cell count then was said to be 1,400,000 with hemoglobin 29 gm. per cent. A transfusion of 350 cc. of blood was given but there was very little improvement. The hemoglobin at this point was 37 gm. per cent and the red blood cell count 1,800,000. Another transfusion of 500 cc. of blood was

given. The next day the pulse was 120, the hemoglobin 42 gm. per cent and the red blood cell count 2,300,000. A portable x-ray showed diffuse consolidation of the lungs. Death occurred three hours later. The patient had received 7,000 cc. of fluid, or 2,000 cc. of blood and 5,000 cc. of glucose solution intravenously, within thirty-four hours.

Autopsy showed pulmonary edema and congestion, bilateral hydrothorax and hematoperitoneum of 500 cc. of blood.

Questions. (1) Of what value are the temperature and laboratory data in the diagnosis? (2) What was the cause of death in these cases?

Answers. The temperature may be normal although slight rises are common. It is most often about 100°F., rarely 101°F. Higher temperatures should make one suspect complication or other disease. A subnormal temperature occurs with sudden internal hemorrhage and collapse and is a useful confirmatory sign. Ruptured ectopic pregnancy is perhaps the only critical abdominal condition likely to show subnormal temperature.

The hemoglobin and red blood cell count are invariably lowered after tubal rupture and severe internal hemorrhage although not necessarily to a degree comparable to the blood loss. Hemoconcentration immediately follows hemorrhage and persists for a few hours. In slowly developing cases the hemoglobin may not be materially reduced. The leukocyte count is generally raised, more so in the severe cases with great blood loss in which it may reach 35,000. Commonly it ranges up to 15,000. Of all the laboratory data the sedimentation rate is of the least value in the diagnosis. However, the combination of a slow sedimentation rate and leukocytosis is of some significance in the diagnosis.

The most valuable laboratory finding is decline in the hemoglobin and red blood cell count on successive examinations in a patient in whom the history and physical findings are inconclusive. It is evidence of progressive internal blood loss; and when it is accompanied with a persistent or increasingly rapid pulse and especially growth or the appearance of a pelvic mass, the diagnosis is certain.

The usual cause of death is hemorrhage and shock, with peritonitis a second leading cause in a surprisingly large number of cases despite chemotherapy and antibiotics. However, these two patients died of pulmonary edema as a result of the use of excessive amounts of intravenous crystalloid solutions. It would almost seem as if the patient in Case VIII was drowned since she received 6,250 cc. of fluid intravenously in less than six hours. The patient in Case IX received 7,000 cc. of fluid in thirty-four hours and this, too, was apparently sufficient to cause pulmonary edema. Although there is no question of the great value of whole blood, large quantities of intravenous crystalloid solutions must be used with some caution, especially when anemia has been slowly progressing and blood dilution has occurred.

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CASE X. The patient was a twenty-eight year old white female, gravida V, para IV, who fainted in the theater after eight weeks of amenorrhea. An ambulance was called and the patient transported to her home. One hour later a second ambulance was called. This time the patient was taken to the hospital.

On admission the patient was in shock. The blood pressure was 60/40 with a pulse of 120. The white blood cell count was 15,500 and the red blood cell count 3,450,000 with a hemoglobin of 10.5 gm. per cent. Posterior colpotomy or puncture of the posterior cul-de-sac was suggested by one of the examiners as an aid to diagnosis but neither of these procedures was performed.

Treatment included morphine sulfate and external heat. The patient was placed in Trendelenburg position and her blood pressure and pulse were charted every ten minutes. In the course of one hour the blood pressure failed to rise and the pulse stayed about the same. The patient did not improve and operation was decided upon in spite of the presence of shock.

At laparotomy a ruptured tubal pregnancy was found and the right tube was removed. During the operation administration of intravenous glucose solution was begun and the patient received 250 cc. of saline with 100 cc. of 10 per cent glucose. By this time a transfusion was begun and about 250 cc. of blood were administered. The patient failed to rally and died after being in the hospital three hours.

Questions. (1) Are puncture and aspiration of the cul-de-sac or posterior colpotomy of any value in the diagnosis? (2) What is the optimum time for operation in a patient in shock

from ruptured ectopic pregnancy? (3) Could this patient's life have been saved?

Answers. Puncture and aspiration of the posterior cul-de-sac are of doubtful value in the diagnosis of ectopic pregnancy. It is most likely to be helpful where it is not needed for diagnosis. When internal hemorrhage is slight and walling-off processes have occurred about the upper levels of the internal genital organs, and in unruptured tubal pregnancy, the test will be negative; yet these are more likely to be the cases in which the diagnosis is difficult. Further, false positives may occur from inadvertent aspiration of a pelvic vein.

We do not use or advise puncture of the cul-de-sac as an aid in the diagnosis. This is also true of posterior colpotomy except in those cases in which a fluctuant mass is palpated in the cul-de-sac and a differential diagnosis between accumulation of blood and pus has not been made. Should posterior colpotomy prove pelvic abscess, the patient has already been treated.

The optimum time for operation, regardless of the condition of the patient, is immediately. In the past there has been division of opinion as to whether operation during shock was indicated and many believed that supportive therapy that included blood transfusion should first be carried out and shock combatted prior to operation. There had also been some doubt as to the advisability of giving blood until operation had begun for it was feared that the blood might escape into the peritoneal cavity or that raising the blood pressure might initiate or increase internal bleeding. It is clear that both blood transfusion and operation should be begun at once and that the time ordinarily required for preparation of the operating room should be sufficient for obtaining compatible blood. There can be no guarantee that if blood transfusion is given and operation delayed the patient will survive until she is a little better operative risk. No urgent obstetric condition responds more promptly or more satisfactorily to surgery than ruptured ectopic pregnancy. The patient stands operation better than other similarly shocked patients. Immediate massive blood transfusion and operation would in all probability have saved the life of this patient.

* * * *

CASE XI. The patient was a twenty-four year old Negro, gravida II, para I. She was first seen by a private physician about fifteen days prior to her death. The details of his examination of the patient at home are meager. However, he noted blood pressure of 120/88, a bluish discoloration of the vagina and a soft cervix.

The patient was next seen by an ambulance surgeon two weeks later. At this time she was found pacing the floor and complaining of severe abdominal pain. She said she had struck her abdomen against the washboard while washing clothes. She was three weeks overdue with her menstrual period and had been informed by her private physician, apparently the one indicated previously, that she was pregnant. She stated also that she had passed what seemed to be a small piece of tissue but failed to save it. The ambulance surgeon put her to bed and on examination found no evidence of abdominal rigidity. The patient was not bleeding but the external os was slightly patulous and there was pain on cervical motion: nothing was felt in the cul-de-sac or in the fornices. She was given codeine and aspirin and advised to stay in bed but to call an ambulance again if she did not get prompt relief.

A second ambulance call came five hours later on the same day. Another doctor answered the call. He found her dead on arrival. She had apparently vomited and gone into immediate collapse.

Autopsy examination showed about 2 quarts of liquid and clotted blood in the peritoneal cavity. After removal of the clots and blood a ruptured ectopic pregnancy of about six weeks' gestation was seen in the left fallopian tube.

Questions. (1) Is histologic examination of tissue passed of any value in the diagnosis of ectopic pregnancy? (2) Will curettage aid in the diagnosis?

Answers. Decidual change in the endometrium normally occurs in all cases of ectopic pregnancy and persists as long as the pregnancy remains undisturbed. When the nutrition of the ovum becomes inadequate, and this occurs relatively early in tubal pregnancy, desquamation of the decidua and hemorrhagic vaginal discharge result. Occasionally shreds of decidual tissue, or even the entire decidua in the shape of a cast, will be passed.

Curettage will yield decidual tissue if desquamation and replacement by other types of endometrium have not occurred. The longer the

period of vaginal bleeding the less likely decidual tissue will be found. If vaginal bleeding in any amount has persisted for more than ten days, all the uterine decidua is likely to have been shed and curettage will yield endometrium of the proliferative, secretory or even menstrual type. In actual practice curettage is positive for decidual tissue in about 20 to 30 per cent of the cases. Even if decidual tissue is found, ectopic pregnancy is not proved, for it can be obtained from intrauterine sites other than that of implantation in very early intrauterine pregnancy.

The greatest value of curettage or examination of tissue passed per vaginum lies in finding chorionic villi when intrauterine pregnancy is proved. In urgent cases there is little time or need for such examination. As a matter of fact, curettage is contraindicated.

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CASE XII. The patient was a thirty year old white primigravida who began to have profuse vaginal bleeding one week past the date for her next expected menses. The bleeding continued intermittently for one week until she was admitted to the hospital for severe abdominal pain. A diagnosis of ectopic pregnancy with fibromyomas of the uterus was made and operation was performed the following morning.

A tubal abortion was removed by salpingectomy. Several hundred cubic centimeters of blood were found in the peritoneal cavity. Following this several intramural and subserous fibromyomas were removed by myomectomies. The patient's condition was poor the next day. Her temperature was 104.5°F., pulse 130 and the abdomen distended. Her temperature remained elevated until her death on the sixth postoperative day. Her course was typical of generalized peritonitis.

Questions. (1) What is the surgical treatment of ectopic pregnancy? (2) Are multiple procedures indicated?

Answers. The surgical management of ectopic pregnancy is the arrest of actual or potential internal hemorrhage by whatever operative means are necessary. In the presence of shock, speed and gentleness are essential. On entering the peritoneal cavity the uterus should first be identified, grasped with a hand, drawn upward out of the wound if possible and held until the source of hemorrhage has been seen. Clamps are then placed on the cornual end of the tube and the mesosalpinx. The ovary should not be sacrificed unless it is so intimately involved in a hematocele that it cannot be freed from the tube. Resection of tubes and salpingostomies are not advised, even if there should be time, for subsequent cornual or interstitial pregnancy may be the sequela. Large, easily accessible blood clots may be evacuated but it is not wise or necessary to remove all blood from the peritoneal cavity.

Once the intra-abdominal hemorrhage is controlled, the operator may be tempted to perform incidental surgery. *This is hazardous, for death from hemorrhagic shock or peritonitis may result.* Appendectomy especially is contraindicated, for hematoperitoneum forms excellent culture medium for the propagation of any pathogenic organisms liberated during the procedure. In rare instances in which the condition of the patient is satisfactory, the incidental pathologic condition serious, the hematoperitoneum slight and the scope of the intended procedure not too great, other procedures may be carried out. This is the exception rather than the rule.

* * * *

CASE XIII.* The patient was a thirty-two year old Negro, gravida II, para I, who visited the outpatient clinic of a hospital for slight abdominal pain and vaginal spotting following three months of amenorrhea. A diagnosis of threatened abortion was made and the patient was advised to return home for bed rest. At 2 A.M. on the day of admission she suddenly complained of extreme hypogastric pain and collapsed. On admission to another hospital she was in profound shock. A diagnosis of ruptured ectopic pregnancy was made.

Glucose solution was infused and followed with blood within fifteen minutes. The systolic blood pressure rose to 90 and the patient was removed to the operating room. At this time the blood pressure was again unobtainable and so a second transfusion was begun in a cutdown left ankle vein.

Laparotomy was performed under cyclopropane anesthesia at 5:15 A.M., at which a rup-

* This patient did not die. The case, to be published by the *New York State Journal of Medicine*, is included because it illustrates the value of intra-arterial transfusion. (From the Department of Obstetrics and Gynecology, State University College of Medicine at New York City.)

tured right interstitial pregnancy was found with a 9 cm. fetus lying free in the abdominal cavity. There was a ragged, necrotic-appearing hole in the right cornual region of the uterus measuring about 3 cm. in diameter. A right hemifundectomy was performed and the abdomen was closed with through and through silk sutures. The operating time was forty minutes. During the operation the blood transfusion in the arm vein infiltrated so that only the ankle cut-down was used, and this under positive pressure. Toward the latter part of the operation the patient was in desperate condition, no pulse or blood pressure being obtainable. On removing the sheets after operation it was noted that the cannula in the ankle vein had become displaced so that the blood had been running freely onto the operating table instead of into the patient's vein. A prompt intra-arterial transfusion under pressure was given into the left femoral artery.

Almost instantaneous return of a palpable radial pulse was noted as the intra-arterial transfusion was begun. It appeared as if an empty arterial bed was being rapidly filled with blood and that the patient, almost dead, was returning to life. About ten minutes later another transfusion of blood was given into the right femoral vein. The patient was given 2,000 cc. of blood in all and made an uneventful recovery.

Questions. (1) What are the special characteristics of interstitial pregnancy? (2) Is there a place for the use of intra-arterial blood transfusion in the treatment of ectopic pregnancy?

Answers. Interstitial pregnancy is the rarest of tubal implantations and occurs in the smallest caliber of the tube where the folds are the simplest. It is the type which most closely simulates normal intrauterine pregnancy in that the uterus becomes larger than in other forms of ectopic pregnancy and positive signs of pregnancy are present. Rupture occurs at a later date because the dense muscular tissue that intervenes between the ovum and the peritoneal cavity hypertrophies, increases its vascularity and meets the needs of the developing embryo. Total amenorrhea is more common in this type.

Diagnosis before rupture is difficult because clinical signs are few until the usual time for rupture of a tubal pregnancy is passed. When symptoms are present, they are likely to be slight and severe internal hemorrhage occurs without warning. Prior to rupture a mass, more or less tender, may be felt in the cornual region of the uterus. It may be difficult to differentiate from pregnancy in a bicornuate uterus or rudimentary horn or from degenerating fibromyoma in a pregnant uterus.

When rupture occurs, internal hemorrhage is likely to be catastrophic because of the great vascularity of this portion of the tube; and in the absence of prompt treatment death ensues speedily. Hysterectomy rather than the operative procedure carried out in this case may be indicated.

It appears that intra-arterial transfusion saved the life of this patient. In the usual case intravenous transfusion will suffice; but when exsanguination has occurred and death impends, there may not be time to replace blood speedily enough by the intravenous route, even with positive pressure in a large vein. It may be dangerous to force large quantities of blood under high pressure through the pulmonary circulation. Further, the time necessary for blood to pass through the pulmonary bed before it reaches the systemic circulation makes rapid filling of the arterial vascular system more difficult.

The rationale of intra-arterial transfusion lies in the retrograde flow of blood up the aorta to perfuse the coronary vessels and the cerebral bed. Rapid filling of the pipelines of an almost empty pumping system also occurs. Experimental data on dogs have indicated the increased effectiveness of this method of transfusion in treating severe, sustained hypotension caused by exsanguination. Clinical experience in its use is still scant but its use in certain cases is warranted. The risk associated with transfusion of blood into the radial artery is lessened when large arteries readily accessible during pelvic surgery are entered.

SUMMARY

Missed or delayed diagnosis is the outstanding contributing factor to the mortality of ectopic pregnancy. The diagnosis of ectopic pregnancy should be considered in all patients in the reproductive age with irregular vaginal bleeding and pelvic pain.

The treatment is immediate blood transfusion and operation. A single 500 cc. blood transfusion will rarely suffice. The intravenous route for transfusion is generally indicated and sev-

eral veins may be used at the same time. The intra-arterial route may be advisable. The volume of fluid given by infusion should not be excessive, for death from pulmonary edema may result.

Shock is not a contraindication to surgery. There is no guarantee that if blood transfusion is given and operation delayed the patient will survive until she becomes a little better operative risk. Ether administered with a large amount of oxygen is the best anesthetic.

The simplest operation required to control actual or potential internal bleeding should be performed. Additional procedures are hazardous.

OCCASIONALLY in children two to four years of age hoarseness and laryngeal dyspnea develop due to multiple laryngeal papillomas (not strictly confined to the vocal cords, as in adults) which are apparently caused by a virus infection that attacks the infantile laryngeal mucous membrane. X-ray therapy is efficacious but may harm surrounding structures and surgical avulsion of the papillomas is frequently followed by recurrence. A successful and conservative measure was recently tried out at the Johns Hopkins Hospital with considerable success. It consists of painting the larynx with a small quantity of strong solution of estrogen in oil (10,000 units per 1 cc.). Apparently this solution "matures" the laryngeal mucosa temporarily and renders it unfertile ground for the papilloma, producing virus. This procedure seems a very logical one and should be tried out on more cases before we can be sure of its undisputed value. It has only been used in a small series of cases to date. (*Richard A. Leonardo, M.D.*)

Practical Surgical Suggestions

EFFECT OF BACITRACIN SUPPOSITORIES ON THE VAGINAL FLORA AND ON MORBIDITY IN VAGINAL HYSTERECTOMIES*

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THE general improvement in operative technic has made total abdominal as well as vaginal hysterectomy a relatively safe procedure in the hands of qualified surgeons. Various methods have been evolved from time to time to attempt to cleanse the vaginal tract of pathogenic microorganisms prior to operation in order to prevent peritoneal contamination. However, up to recently the reported morbidities following total hysterectomy remained quite high even though the mortality rates have been very low. In a recent report by one of us[1] it was shown that the introduction vaginally of a 100,000 unit penicillin suppository the night before operation resulted in a marked reduction in postoperative morbidity, hospital stay and complications in general. Bacteriologic studies revealed a significant reduction in the number of organisms in the vaginal tract following the use of such a suppository which most likely accounted for the excellent clinical results. Nevertheless, it appeared to us that for this purpose certain of the newer antibiotics might overcome some of the inherent disadvantages of penicillin, and therefore a similar study was undertaken with bacitracin.

Meleney and Johnson[2] announced the discovery of bacitracin in 1945. They found that bacitracin had an antibacterial spectrum comparable to penicillin and produced excellent results when employed locally in a variety of infections of the skin and the mucous membranes. Of the eighty-nine strains of bacteria these authors studied *in vitro* fifty-three were sensitive equally to bacitracin and penicillin, thirty were sensitive to bacitracin and resistant to penicillin, and only six were resistant to bacitracin and sensitive to penicillin. Miller, Slatkin and Johnson[3] obtained good results with bacitracin locally in 120 patients with a variety of skin infections. Comparable effects were obtained by Eichenlaub and Olivo,[4] Derzavis, Rice and Leland,[5] and Blattner.[6] Other authors[6,7] state that bacitracin as compared with penicillin and the sulfonamides has an extremely low rate of sensitization. Favorable results were also reported when bacitracin was administered locally for infections of the ear and pharynx[8] in cases of sinusitis[9] and in ocular infections.[10]

Bacitracin seems to be highly effective against local bacterial infections; it has a low rate of allergenicity; bacteria rarely develop resistance to it and no naturally occurring substance comparable to penicillinase has as yet been found.

MATERIALS AND METHODS

In this study there were 128 patients undergoing vaginal hysterectomies by members of the gynecologic staff at the Mount Sinai Hospital. Ages ranged from thirty-four to seventy-two. Vaginal cultures were taken with aseptic precautions the night before operation prior to any vaginal treatment. After expulsion of the preoperative enema, in seventy of these patients 10,000 units of bacitracin in the form of a cocoa butter suppository were inserted deep into the vagina. In the other fifty-eight patients a 1 per cent iodine douche and/or a plain cocoa butter suppository was employed.

* From the Department of Obstetrics and Gynecology of the Chicago Medical School and Mount Sinai Hospital, and the Department of Bacteriology of the Mount Sinai Medical Research Foundation, Chicago, Ill. Aided by a grant from the Commercial Solvents Corporation, New York, N. Y.

TABLE I

VAGINAL FLORA OF UNTREATED PATIENTS AND PATIENTS TREATED WITH ONE 10,000 U. BACITRACIN SUPPOSITORY

	Untreated, 50 Cases				Treated, 70 Cases				
	1st Culture		2nd, 12-14 Hr. Later		1st Culture		2nd, 12-14 Hr. Later		
Organisms	No.	%	No.	%	No.	%	No.	%	P*
Hemolytic staphylococcus aureus	22	44	15	30	28	40	9	12.8	.019
Non-hemolytic staphylococcus aureus	23	46	20	40	19	27.1	3	4.3	<.001
Staph. albus	17	34	14	28	17	24.3	4	5.9	.001
Anaerobic staphylococcus	0	0	0	0	2	2.9	0	0	...
G. tetragena	10	20	6	12	11	15.7	1	1.4	.021
Alpha-viridans streptococcus	5	10	5	10	7	10	1	1.4	.045
Beta-hemolytic streptococcus	6	12	8	16	10	14.3	3	4.3	.031
Non-hemolytic streptococcus	10	20	12	24	11	15.7	3	4.3	.002
Enterococcus	5	10	3	6	8	11.4	4	5.9	.375
Microaerophilic streptococcus	0	0	1	2	2	2.9	2	2.9	...
Anaerobic streptococcus	4	8	3	6	7	10	1	1.4	...
D. pneumoniae	4	8	2	4	1	1.4	0	0	...
Anaerobic Neisseria	2	4	1	2	0	0	1	1.4	...
Diphtheroids, aerobic and anaerobic	19	38	16	32	25	35.7	3	4.3	<.001
Aerobic spore-forming rods	10	20	13	26	13	18.6	2	2.9	<.001
Bacteroides	7	14	6	12	8	11.4	6	8.6	.375
Esch. coli	11	22	12	24	25	35.7	18	25.7	.50
A. aerogenes	2	4	7	14	7	10	3	4.3	.062
Paracolon	2	4	3	6	1	1.4	1	1.4	...
Proteus	0	0	0	0	1	1.4	2	2.9	...
Ps. aeruginosa	0	0	0	0	1	1.4	2	2.9	...
Unidentified gram-negative rods	8	16	7	14	3	4.3	1	1.4	...
Lactobacillus	17	34	15	30	30	42.9	6	8.6	.003
C. albicans	5	10	4	8	5	7.2	8	11.4	...
Candida, other species	3	6	5	10	5	7.2	9	12.8	...
Cryptococcus	1	2	1	2	3	4.3	2	2.9	...

Bacteria isolated once: Untreated: 1st culture, Achromobacter, A. fecalis; 2nd culture, A. fecalis

Treated: 1st culture, Achromobacter, S. alkalescens;† 2nd culture, Achromobacter, S. alkalescens,† S. cubana‡

*The probability that the difference found could have arisen due to random sampling error only. This has been calculated by the χ^2-square method with Yates correction. Thus a figure of P .031 means that this difference might be observed by chance 31 times in 1,000 pairs of random samples of the same sizes. (See Fisher: Statistical Methods for Research Workers, p. 95, 10th ed. London. Oliver & Boyd.)

†Two repeat cultures on the same patient revealed the same organism as did her stool. Its role as a possible pathogen under the circumstances is decidedly doubtful.

‡This organism, very rare in humans, was also isolated from the stool, urine and repeat vaginal cultures. This patient had been diagnosed as having carcinoma of the bladder; postoperatively her genitourinary symptoms persisted and have abated under chloromycetin therapy.

The vaginal cultures were then repeated twelve to fourteen hours later. The vagina was then cleansed with zephiran and the operative procedure carried out. Eight patients receiving bacitracin underwent abdominal hysterectomy and were therefore not included in the clinical results. In another eight patients who received no antibiotic the cultures were lost. There is therefore a slight discrepancy between the number of cases studied clinically and bacteriologically.

TABLE II

IN VITRO SENSITIVITIES OF BACTERIA ISOLATED FROM THE VAGINAL TRACT AGAINST BACITRACIN AND PENICILLIN

Organism	No. Strains	Bacitracin-sensitive Penicillin-sensitive	Bacitracin-sensitive Penicillin-resistant*	Bacitracin-resistant* Penicillin-sensitive	Bacitracin-resistant Penicillin-resistant
Hemolytic staphylococcus aureus, coag. pos.	14	8	3	3	0
Hemolytic staphylococcus aureus, coag. neg.	9	2	5	2	0
Non-hemolytic staphylococcus aureus, coag. pos.	8	7	1	0	0
Non-hemolytic staphylococcus aureus, coag. neg.	8	5	0	3	0
Staph. albus, coag. pos.	5	5	0	0	0
Staph. albus, coag. neg.	6	5	1	0	0
α-viridans streptococcus	6	5	1	0	0
β-hemolytic streptococcus	10	7	3	0	0
Enterococci	14	0	14	0	0
D. pneumoniae	1	1	0	0	0
Diphtheroids	7	6	1	0	0
Esch. coli	13	0	0	0	13
Other enteric bacilli	4	0	0	0	4
Lactobacillus	1	1	0	0	0

*Bacitracin-resistant >5.0 units; Penicillin-resistant >1.6 units.

The bacteriologic studies were carried out as follows: One swab was placed directly in trypticase soy broth plus 0.1 per cent agar and another streaked on 5 per cent human blood agar, eosin–methylene blue agar, Sabouraud's dextrose agar, phytone-dextrose-serum agar and broth[11] and into Brewer's thioglycollate medium. Subcultures were made aerobically and anaerobically, utilizing a Brewer's anaerobic jar, on a wide variety of culture media.

Streptococci which grew only under reduced oxygen in original culture were considered microaerophilic. Enterococci were identified according to the criteria of Sherman.[12] Gram-negative bacilli were identified by biochemical and serologic means. Anaerobic organisms were considered as such only when aerobic subcultures failed to grow. Lactobacilli were isolated and identified mainly by the methods recommended by Gilmore[11] which we found superior to the many others in the literature. Yeast-like organisms were classified by their production of mycelia, by carbohydrate fermentations and production of chlamydospores in the Congo Red–cornmeal broth of Anderson,[13] according to the outline of Martin et al.,[14] and Jones and Martin.[15] No attempt was made to identify spirochetes, pleuropneumonia-like organisms or protozoa, these being outside the province of this study.

In vitro sensitivities to bacitracin and penicillin were performed on 104 of the organisms isolated from the vaginal cultures. These were

selected at random with no attempt being made to choose any particular variety. A slightly modified broth tube assay technic of Kolmer[16] using trypticase soy broth as the menstruum was used. Organisms requiring more than 1.6 units of penicillin[17] and more than 5.0 units of bacitracin for inhibition[18] were considered as "resistant." Coagulase tests were performed on the staphylococci by the method of Gillespie.[19]

TABLE III

IN VITRO SENSITIVITIES TO BACITRACIN AND PENICILLIN AND SURVIVAL OF BACTERIA IN CULTURES AFTER TREATMENT WITH BACITRACIN SUPPOSITORIES, 10,000 UNITS

Organism	Growth in Cultures Before Treatment	Growth in Cultures After Treatment	No. Strains	Bacitracin-sensitive Penicillin-sensitive	Bacitracin-sensitive Penicillin-resistant*	Bacitracin-resistant* Penicillin-sensitive	Bacitracin-resistant Penicillin-resistant
Staphylococci	+	+	6	3	1	2	0
	+	-	29	20	6	3	0
	-	+	3	2	0	1	0
Non-hemolytic streptococcus	+	+	2	2	0	0	0
	+	-	4	2	2	0	0
Hemolytic streptococcus	+	+	1	1	0	0	0
	+	-	3	3	1	0	0
Enterococci	+	+	6	0	6	0	0
	+	-	2	0	2	0	0
Esch. coli	+	+	8	0	0	0	8
	+	-	4	0	0	0	4
	-	+	1	0	0	0	0
Other enteric bacilli	+	+	2	0	0	0	2
	-	+	1	0	0	0	1
Lactobacillus	+	-	1	1	0	0	0

*Bacitracin resistant >5.0 units; Penicillin resistant >1.6 units.

RESULTS

The number and percentage of organisms isolated before and after the insertion of the bacitracin suppositories are listed in Table I. The reduction in the number of gram-positive pyogenic cocci, diphtheroids and lactobacilli was striking and the decrease is definitely statistically significant. As might be expected, the gram-negative bacilli and yeast-like organisms were not affected by the bacitracin.

The comparison of the *in vitro* sensitivities of bacteria isolated from the vaginal tract to bacitracin and penicillin is presented in Table II. Among the pyogenic cocci only eight proved to be bacitracin-resistant (> 5.0 units) whereas twenty-eight were penicillin-resistant (> 1.6 units). Especially noteworthy is that of the fourteen isolates of enterococci, all were penicillin-resistant and bacitracin-sensitive. In no case, except in the coliform rods, were any organisms encountered that were both penicillin- and bacitracin-resistant.

The correlation between *in vitro* sensitivities and the survival of the bacteria after exposure to bacitracin is shown in Table III. Only a few of the organisms sensitive *in vitro* to bacitracin survived in the second cultures. It is doubtful that these represent strains whose resistance has increased *in vivo* after exposure to bacitracin. Such a phenomenon, although relatively common with penicillin, is rare with bacitracin.[20]

The clinical results as to morbidity and postoperative hospital stay are listed in Table IV. In the bacitracin series four patients had to be treated postoperatively with penicillin and/or sulfonamides and one with dicumarol for a suspected phlebothrombosis. There was a total

of thirteen morbidity days or an average of 3.2 days per patient with morbidity.

The control series had sixty-nine days of morbidity or an average of 4.6 days per patient with morbidity. Seventeen patients had to be treated with antibiotics and/or sulfonamides for from three to six days postoperatively. There were no deaths in this entire series and no untoward reactions attributable to the use of the bacitracin.

TABLE IV

EFFECT OF BACITRACIN SUPPOSITORIES ON MORBIDITY AND POSTOPERATIVE HOSPITAL STAY IN VAGINAL HYSTERECTOMIES

Vaginal Treatment Night before Operation	No. of Cases	Morbidity* No.	Morbidity* %	Average Postoperative Hospital Stay
Bacitracin suppository	62†	4	6.4	9 days
1% iodine douche and/or plain cocoa butter suppository	58‡	15	25.9	10.6 days

*Morbidity computed in accordance with the standards of the American College of Surgeons.

†Including 45 anterior colporrhaphies, 48 perineorrhaphies, 18 bilateral salpingo-oophorectomies and 10 unilateral salpingo-oophorectomies.

‡Including 34 anterior colporrhaphies, 52 perineorrhaphies, 16 bilateral salpingo-oophorectomies and 11 unilateral salpingo-oophorectomies.

COMMENTS

It is recognized that this procedure introduces two possible sources of error that must be considered in the evaluation of the results. First, the cocoa butter used as a vehicle may form a viscous layer around the vaginal vault so that a portion of this material taken up by the cotton swab might reduce the number of bacteria mechanically. To determine how important this factor might be approximately half of the control patients were given plain cocoa butter suppositories; little or no effect in reducing the number of organisms in the second cultures was evinced. Secondly, a swab taken from an area where a high concentration of antibiotic is present undoubtedly carries with it a large amount of the drug. In the case of penicillin such an effect can be largely obviated by adding sufficient penicillinase to the culture media. In the case of bacitracin no such naturally occurring enzyme has as yet been discovered and reliance had to be placed in culturing and diluting the material as soon as possible after the specimen was taken. It is not known exactly what effect this factor may have had on the results obtained. However, we believe that the sensitivity *in vitro* to bacitracin of most of the organisms isolated and the findings being so similar to those obtained in the series with penicillin[1] where penicillinase was employed lend validity to our results.

The fact that the clinical results as to morbidity have paralleled those of the series with penicillin adds further evidence that the 10,000 unit bacitracin suppository *per se* is effective in clearing the vaginal tract of those bacteria which most likely play an important role in the high morbidity rate and increased postoperative hospital stay following vaginal hysterectomies. It is our opinion that bacitracin is at least as useful as penicillin prophylactically in vaginal hysterectomies and should be worthy of use in all vaginal operations.

Similar suppositories are being employed in the treatment of various types of vaginitis and cervicitis with gratifying results. Detailed data on this work will be published at a later date.

SUMMARY

1. Patients undergoing vaginal hysterectomies were given bacitracin prophylactically in the form of vaginal suppositories containing 10,000 units.

2. Cultures taken twelve to fourteen hours after insertion of the suppository revealed a marked reduction in the number and variety of organisms.

3. *In vitro* resistance studies showed a high incidence of penicillin-resistant and a low incidence of bacitracin-resistant bacteria.

4. A striking reduction in postoperative morbidity and number of patients requiring additional medication was found in the bacitracin series as compared to the controls.

5. No untoward reactions to this antibiotic were encountered.

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PREOPERATIVE USE OF THE COMPRESSIVE BANDAGE IN TREATMENT OF VENOUS INSUFFICIENCY IN THE LOWER EXTREMITIES*

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DESPITE the attention given to it in the past decade the treatment of primary and secondary venous insufficiency and their associated complicating sequelae remains a challenging problem. A method of compressive bandage treatment is described which has proved of value in the preoperative preparation of patients with varicose and postphlebitic ulcers, eczema, phlebitis and postphlebitic venous insufficiency.

TECHNIC

The compressive bandage consists of two layers. The first layer is a cotton† roll and the second layer is an elastic bandage. The use of the cotton roll is preferred over other types of materials because of the following: (1) the inherent tensile strength, (2) the greater absorptive qualities, (3) the ease of application and (4) the spongy quality which makes it useful over areas subject to pressure necrosis and over the "feeder" varicosities in juxtaposition to the ulcer. The second or outer layer consists of a 4 inch wide elastic bandage. The type used is one of densely woven lastex.‡ It is more durable and retains its elasticity longer than the plain cotton variety.

In the application of the first layer the foot of the patient is held by an assistant at a 90 degree angle to the leg and the knee is flexed at a 15 degree angle. The bandage is started on the medial aspect of the foot at the level of the head of the first metatarsal bone. Slight tension is applied as the wrapping is begun. The bandage is applied perpendicular to the long axis of the foot and leg. The heel may or may not be included. If the lesion under treatment is close to the heel, it is included in the bandage. The inner layer is carried to a level just above the tibial tubercle. At this level the bandage is applied in double or triple layers to protect the bony prominences. Wrinkling in any portion of the bandage is avoided since local pressure necrosis may occur. Additional padding is applied over the malleoli, Achilles tendon, anterior aspect of the tibia and over the "feeder veins" surrounding the ulcer area. (Fig. 1A and 1B.)

In the application of the second or outer layer it is important to apply firm and even compression. The folds of the bandage are perpendicular to the leg, and as previously the heel may or may not be included, depending upon the individual requirements. Two adhesive strips are placed about the heel to prevent sliding of the bandage. (Fig. 1C and 1D.)

When the area under treatment is above the knee, the application of the bandage is difficult because of its tendency to slide. The first layer of the cotton roll is started just above the knee and extends to just below the groin. In the application of the second or outer layer an elastic adhesive bandage§ is preferred to the plain elastic bandage because of its adherent quality. This layer is extended above and below the underlying cotton layer to secure anchorage to the skin. (Fig. 2.) When the thigh is very obese, a more simple technic is used. Strips of cotton roll and strips of elastic adhesive bandage are placed perpendicular to the long axis of the thigh extending one-half to three-quarters around its circumference. In the application of the adhesive strips firm compression is used. (Fig. 3.)

In the patient with a "weeping" eczema a mild astringent such as bismuth subgallate is sprinkled liberally over the area and is covered by a piece of gauze of adequate size. If the eczema is dry and there is no existing

† Webril bandage (Curity).
‡ Ace No. 8 (Becton, Dickinson and Co.).
§ Elastoplast (Duke Laboratories, Inc.).

* From the Department of Surgery, St. Clare's Hospital, New York, N. Y.

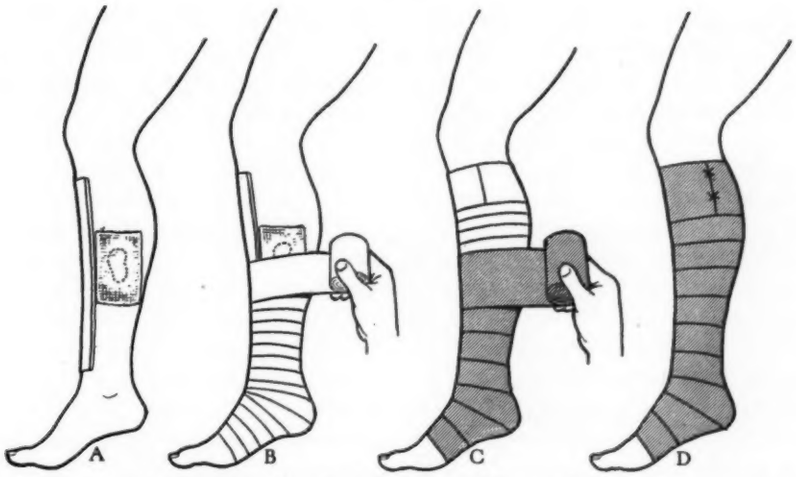

FIG. 1. A and B, Application of protective padding and sterile gauze sponge over the tibial prominence and ulcer area, respectively. The first or cotton layer is being applied. C and D, technic and application of the second or elastic bandage layer.

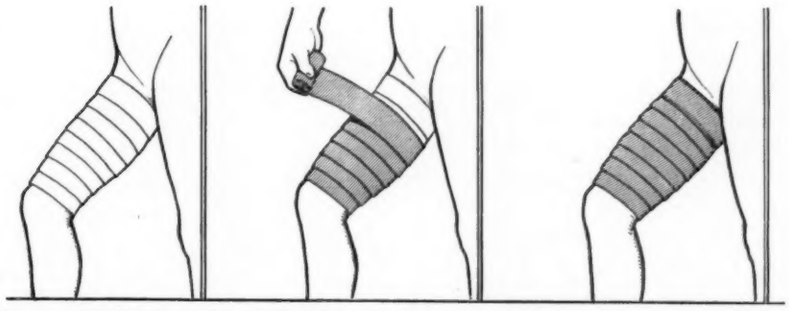

FIG. 2. Technic in the application of the compressive bandage to the thigh.

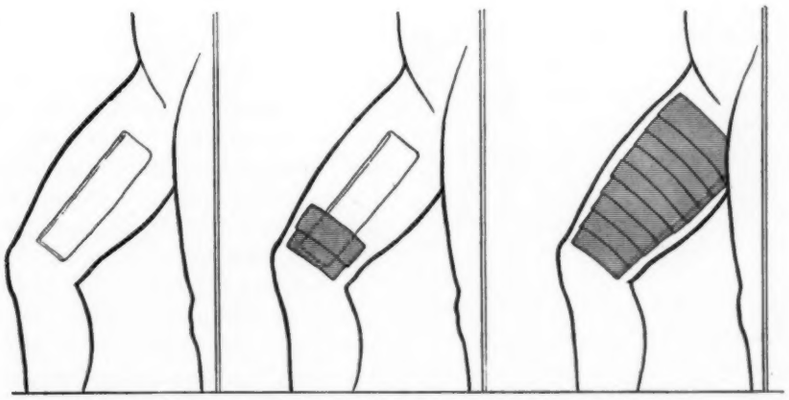

FIG. 3. A modification of the bandage technic that is employed in the obese.

allergy, a tar ointment* is used. In the presence of a secondary fungus infection a fungicidal drug is employed.† If there is an ulcer, it is covered by a sterile gauze pad.

Upon completion of the application of the bandage the patient is instructed to walk a distance of several blocks and then to return for examination. If at this time the patient complains of pain, the elastic bandage is readjusted. If these precautions are not observed, painful pressure areas and even pressure necrosis may occur over the anterior aspect of the tibia, malleoli, Achilles tendon or instep.

To obtain the most beneficial effect on the venous circulation instructions are given to the patient relative to the proper use of the leg muscles. This is best accomplished by ordinary walking. Standing for long periods should be avoided. The use of crutches or other support is prohibited. In the sitting position the leg should be elevated to the height of an ordinary footstool. Patients with painful ulcers are supplied with an analgesic sufficiently strong to enable them to walk without splinting the leg since muscle action is essential for the correction of the venous insufficiency. Pain usually disappears quickly simultaneously with the reduction of the edema. The subsidence of the edema and/or the exudation from the ulcer usually necessitates a change of the first bandage within three to four days. However, following application of the second bandage weekly or biweekly change of the compressive bandage is sufficient.

COMMENTS

The surgical treatment of venous insufficiency in the lower extremities is beyond the scope of this paper. The compressive bandage method is used routinely in the preparation of patients for surgery. Its use as a definitive treatment is limited to patients in whom surgery is contraindicated or to those who refuse operation.

In employing the compressive bandage in the treatment of venous insufficiency in the lower extremities proper application of the bandage is of prime importance. The pressure gradient decreases from below upward, so that no blood is trapped in the veins which are under compression. Meticulous attention to detail results in the rapid healing of the lesion. Heretofore in many clinics the results obtained by the compressive bandage treatment have been inconclusive. It is believed that with the proper attention to detail in the application of the compressive bandage improved results will be obtained. It is imperative that the bandage should be applied only by experienced personnel. If this is not insisted upon, difficulties will arise.

All objectives of the bandage treatment can be obtained by bed rest and elevation of the affected extremity. However, this represents a merely passive means of relieving the venous insufficiency, adds to the already existing muscle atrophy and disability, and incurs considerable expense. The cardinal factors in the pathogenesis of venous insufficiency (viz., venous hypertension, valvular incompetence, edema, tissue necrosis, thrombosis and fibrosis) are all benefited by the compressive bandage treatment. This treatment permits ambulation, overcomes muscle atrophy by active exercise, assures rapid resolution of the edema, stimulates healing processes and returns the patient to a working capacity.

It may be interesting to observe that upon healing of the lesion many veins that were not apparent prior to treatment with the compressive bandage become easily visible and palpable, and therefore are more readily amenable to surgery.

In the early treatment of the postphlebitic syndrome, after the initial acute phase has subsided, it is generally agreed that the use of the supportive bandage is essential until the edema has subsided. However, in patients so afflicted the usual support given to the leg and the proper bandaging is frequently neglected. This predisposes the patient to chronic lymphedema and its associated sequelae. The use of the compressive bandage offers much to these patients. It forces them to remain under continual medical observation, gives adequate support to the venous circulation, prevents development of secondary varicose degeneration and ulceration, protects the skin and keeps the patient in full working capacity.

The disadvantages of the compressive bandage treatment encountered are as follows: (1) The cosmetic aspects of the bandage are sometimes undesirable; (2) frequently patients will refuse surgery for definitive cure because the compressive bandage has given them relief from the manifestations of the venous insufficiency.

* Daxalan ointment (Dome Chemicals, Inc.).
† Desenex ointment (Wallace and Tiernan).

The advantages of the compressive bandage treatment are: (1) It relieves pain and restores the patient to full working capacity within a few days; (2) in contrast to bed rest it prevents muscle atrophy and general disability; (3) it effects resolution of the edema and induration, and rapid healing of existing ulcers and/or eczema; (4) it maintains adequate venous circulation in patients in whom surgery is contraindicated. Accordingly, the compressive bandage treatment may be termed a "medical vein ligation."

RESULTS

In the period from January, 1948, to December, 1949, fifty-seven patients with stasis ulcers of the lower extremities were treated in the vein clinic of St. Clare's Hospital. These patients were classified into two groups as follows:

Group I. This group comprised thirty-one patients with varicose ulcers. The ulcers were present for an average duration of one and a half years. Following application of the compressive bandage treatment healing was obtained in an average period of three weeks.

Group II. This group comprised twenty-six patients with postphlebitic ulcers. These ulcers were present for an average duration of seven years. Following the application of the compressive bandage treatment healing was obtained in an average period of three and a half weeks.

SUMMARY

A method of ambulatory treatment of venous insufficiency in the lower extremities and its associated sequelae is described. Its advantages over other methods as a preparatory treatment to definitive surgery is discussed. Its use in the prevention of the frequently irrevocable sequelae of the postphlebitic syndrome is stressed. The compressive bandage treatment is recommended as a definitive treatment in those patients in whom surgery is contraindicated.

SIMPLE METHOD OF LOCALIZING FOREIGN BODIES IN THE HAND*

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IN a previous publication[1] a method of localizing and removing foreign bodies from the hand was described. Employment of the fluoroscope was recommended for both procedures. More recently, in order to decrease fluoroscopic exposure an alternate method was developed for localizing the foreign body. The simplicity of the procedure and the accuracy of the results have prompted this report.

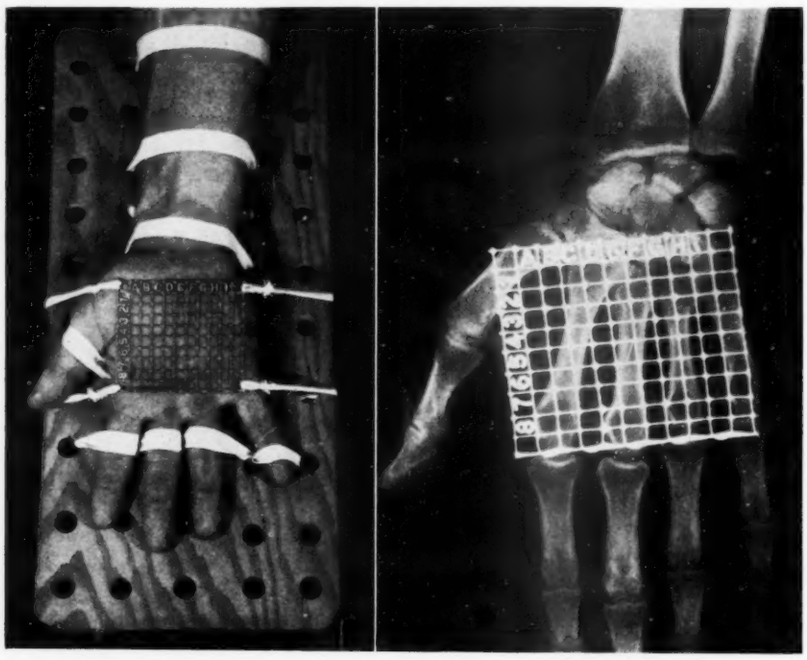

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FIG. 1. Shows the hand and forearm fixed to the operating board and the localizing screen tied in place. (Illustration from The Chicago Medical School.)
FIG. 2. Shows the exposed and developed x-ray film as it will appear to the operator; note the needle in square E5. (Illustration from The Chicago Medical School.)

The apparatus consists of a wire mesh screen about 2 inches square in which the smaller subdivisions are about ¼ inch square. One-fourth inch lead numerals are fixed in the squares on one side of the screen, and similar-sized lead letters are fixed in the squares on an adjacent side. Self-curing dental plastic makes an easily available and serviceable material for this fixation. Cloth tapes of any desired length are tied or sewn to the four corners of the screen. The apparatus can be sterilized by boiling.

The hand is cleansed and surgically prepared as the surgeon desires and is fixed to the operating board. (Fig. 1.) All localization and surgery will be performed in this fixed position since one of the important principles is that the surgical approach to the foreign body must be performed with the anatomic part in the same position as it was during localization. The small screen is tied to the palm of the hand (assuming that the radiopaque foreign body is in the palm) and the hand is x-rayed. During this procedure

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the fixing board should lie flat upon the x-ray film and the x-ray tube should be at least 40 inches from the film and focused on the screen.

The developed but still wet film will show the position of the foreign body on the screen. The letters and numerals serve as guides. With the screen still fixed to the hand there is no problem in transposing with an indelible dye to the surface of the palm the position of the foreign body as observed on the x-ray film. Experiments and experience with foreign bodies have shown the localization to be extremely accurate. (Fig. 2.)

Since the hand has been surgically prepared and has not since been contaminated, the screen can be untied and removed and the surgeon may proceed with the operation. We still remove the foreign body, usually a broken needle, with the aid of the fluoroscope. The operation is always performed as an outpatient case under local anesthesia. The incision is frequently so small as to render suturing unnecessary. Disability is negligible.

CONCLUSION

A simple apparatus for localizing radiopaque foreign bodies in the hand is presented. It can be personally constructed by any surgeon at very little cost and will prove to be accurate and helpful in an operation which is too often difficult and embarrassing.

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Patients with coarctation of the aorta have a poor prognosis unless a successful operation is performed upon them since many of them die before reaching their fortieth year. Vascular surgeons are now able to use special instruments and excise the coarctation and then anastomose the proximal and distal portions of the aorta to restore circulation. However, if too great a tension occurs in a few of these cases, surgeons have successfully anastomosed the resected aorta with the left subclavian artery after the latter has been freed and severed between clamps some 4 cm. from the aortic arch. (*Richard A. Leonardo, M.D.*)

SUTURE TIE BOX*

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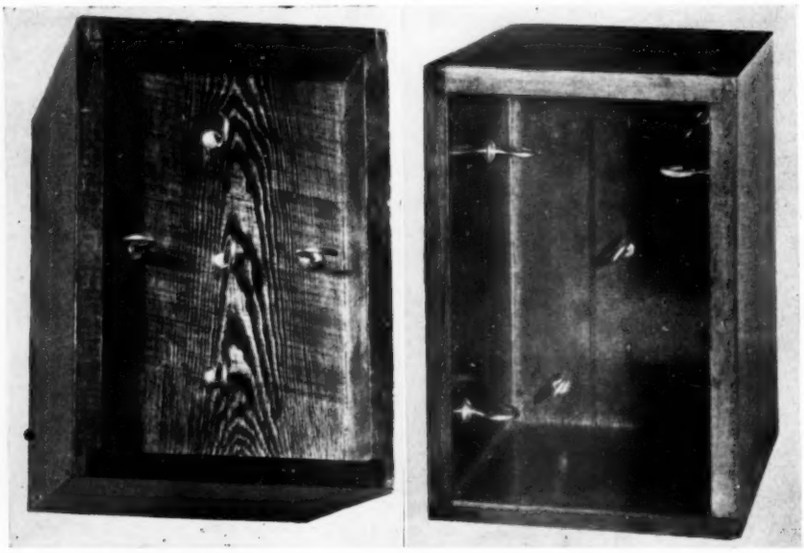
ONE index of the efficiency of a top grade first assistant in the operating room is his ability to tie secure knots with reasonable speed. First assistants like to and should take an active part in the operation, and it is a general rule that if they can tie sutures with ease and accuracy they are allowed to do so. However, if they are fumblingly slow or tie insecure knots, the surgeon generally takes over the job.



1A 1B

FIG. 1. A simply constructed box for practicing the tying of sutures. Outside dimensions: 9 inches long, 6 inches wide, 7 inches deep. Material ½ inch soft pine; hooks ¾ inch in diameter. A, shows the bottom inset 1⅝ inch in order that the hooks do not protrude and catch on various objects; B, inside of box with bottom at 4⅞ inch. The hooks are placed at different depths so that tying-in-a-hole can be practiced.

Tying sutures is not a procedure to be learned in the operating room; and since skill is acquired only by long practice, it has been the custom for a good surgical house officer to keep string, thread or discarded suture material on hand in his room so that time can be spent learning this art. At first it is better to use large material like string in order to see whether a square knot or a "granny" has been tied. The manner of tying sutures varies with different surgeons (two-handed ties, one-handed method or tying with forceps) so the beginner should learn to tie knots in several ways; and if he is particularly thoughtful, he will use the method employed by the surgeon he is assisting, changing his technic as he changes surgeons.

Figure 1 shows a simply constructed box, the like of which should be on hand in every house staff quarters for practicing the tying of sutures. With the user sitting the box can easily be held between the knees, which is a comfortable level for hand work.

It is well known that competition among interns and residents for better positions is extremely keen and grading of the candidates goes on all the time. Therefore, outstanding ability in the operating room is something to work for. The skillful hands of the surgeon put much of his training and experience into effect and the neophyte should learn manual dexterity early. This practice box should be of considerable aid to the art of tying sutures.

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Case Reports

IMPALEMENT PERFORATIONS OF THE PERINEUM*

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IMPALEMENT perforations of the perineum may cause some of the most serious and unusual injuries which require surgical attention. The severity of these injuries is influenced by the direction in which the impaling object enters the perineum, the size and shape of the object and the depth of penetration. Perforations following perineal impalement have occurred in the rectum, bladder, urethra, intestinal tract, kidney, diaphragm and adnexa. When perforations into the peritoneal cavity occur, the results are serious and frequently fatal, especially when intraperitoneal viscera are penetrated. Those perforations which do not enter the peritoneal cavity are often followed by rapid healing although abscess and fistula formation may complicate recovery.

The impaling instrument may enter the perineum through the anus or vagina and penetrate these organs at a higher level from within outward. This generally occurs when a blunt object is the impaling force. The perineum may also be pierced at the point of contact and then secondary perforation of the rectum, vagina, bladder or other viscus from without inward occurs.[7] This is the type of injury which follows impalement by a sharp object. All of the cases described herein are examples of the latter type.

A number of objects have caused impalement injuries. Pitchfork handles, sharpened stakes, picket fences and horns of animals are the most common. Less frequently, impalement has been due to tree branches, stumps of weeds, iron bars, chair legs and many other sharp devices.

The occurrence of impalement is most frequent in agricultural communities, affecting mainly adult males.[15–17] This is to be expected in view of the common causes. Numerous reports of rectal impalements have appeared since Van Hook's[24] in 1896. Summaries of previously reported cases, with additional new cases, were made by Stiassny,[21] Tillmann[22] and Habhegger.[9] In 1939 Claggett[5] stated that approximately 200 cases of impalement of the rectum had been reported in the literature. Many of these involved the bladder or other viscera as well as the rectum. Since then several single case reports have been published.[10,17,20]

Powers and O'Meara[15] observed three patients with impalement injuries in 10,551 hospital admissions in a rural district and Neumann[13] reported twenty instances of impalement in 16,000 admissions. According to Seybold, Black and Jackman[17] seven patients with impalement of the rectum and damage to intraperitoneal viscera were encountered at the Mayo Clinic from 1910 to January 1, 1939. Examples of impalement involving the urinary bladder have been reported by Cottam,[8] Brigg,[4] Smith,[20] Rastelli and Nascimbene,[16] Bonvallet[2] and Neumann.[13]

The incidence of mortality in impalement injuries associated with damage to intraperitoneal viscera is high. Tillmann[22] reported a 76.4 per cent mortality rate in thirty-four cases. Habhegger[9] recorded forty-two cases with a mortality of 78.5 per cent and Van Hook[24] observed that if the peritoneum was penetrated the death rate was 71.4 per cent. All of these publications appeared many years before the use of antibiotic and chemotherapeutic agents.

Without intraperitoneal penetration the mortality rate as given by most authors was less than 10 per cent.[9,13,21,22,24] Seybold and others[17] reported five recoveries and two deaths

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in the seven cases at the Mayo Clinic from 1910 to 1939. Their additional (eighth) patient, reported in 1944, recovered.

The impaling object and manner in which the injury occurred are usually evident from the history. The depth of penetration, however, is not easily determined. Symptoms are often mild in the period following injury. Pain may not be severe and only a small external wound may be visible in the perineum. If the impaling object enters the anus or vagina directly, no external wound is present. Subsequently, symptoms appear as a consequence of infection or hemorrhage. Bleeding from the anus or vagina may be observed. Inability to urinate or hematuria may be noted. Localized hematoma formation in the perineum is often present. Tears in the rectum may be palpable or visible through the proctoscope. After a varying length of time signs of peritonitis may become evident which are often followed by shock.

MANAGEMENT

Any patient who sustains an impalement injury, no matter how mild the clinical manifestations are when first examined, should be admitted to a hospital. It is only as a hospital patient that the severity of the injuries may be properly evaluated.

During examination of the patient, which is carried out as soon as possible after the injury, attention is centered upon certain organs and areas of the body. These are: (1) the abdomen, (2) bladder and urethra, (3) vagina and (4) rectum. A roentgenogram to disclose subdiaphragmatic air, if present, must be obtained. Careful physical examination of the abdomen for signs of peritonitis should be performed and repeated frequently if necessary. If the patient does not urinate spontaneously, the bladder should be catheterized. In passing the catheter a ruptured urethra may be discovered. If catheterization is successful and urine is obtained, the presence of hematuria is significant. Cystograms may be obtained if indicated. To detect a vaginal perforation examination by the ordinary bimanual method and also with a speculum should be carried out. Both digital rectal and proctoscopic examinations should be performed. By using the proctoscope a perforation which might not be palpable may be found.

If evidence of intraperitoneal perforation and peritonitis is present, immediate laparotomy is indicated. Perforations of the bladder are sutured but diversion of the urine must be established and this is probably done best by suprapubic cystostomy. Perforations of the colon or intraperitoneal rectum may be sutured but it is also necessary to establish proximal colostomy so that the fecal current will be diverted. Other perforations encountered in the peritoneal cavity involving, for example, small intestine, stomach or other viscus must be managed according to the individual surgeon's judgment, skill and experience.

Peritonitis accompanying impalement perforation is treated with antibiotic and chemotherapeutic agents, blood transfusions, parenteral fluids, intestinal decompression and all the other well known measures which have been emphasized in other publications.[6,11,23]

Prophylactic tetanus antitoxin has been recommended as an adjunct in the treatment of impalement injuries and should be administered in adequate amounts.[3,10]

In extraperitoneal wounds involving the perineum and rectum saucerization and drainage without suturing has been advocated.[1] Soon after injury, however, some of the more superficial injuries may be successfully closed primarily. Some of the deeper, more extensive extraperitoneal wounds of the rectum may require proximal colostomy in addition to saucerization and drainage.

Urethral injuries present special problems. Besides repairing the urethral defect, if possible, it is necessary to divert the urine and establish drainage to prevent or treat already existing urinary extravasation. Antibiotic and chemotherapy is also indicated in the postoperative period following extraperitoneal perforations.

CASE REPORTS

Case 1. W. F., a fifteen year old white male, was admitted to St. Anne's Hospital on May 9, 1948. Twenty-three hours before admission he was high-jumping and in attempting to clear the wooden crossbar, struck it and broke it. As he fell to the ground, a portion of the splintered wood entered his perineum near the anus. He removed the splinter which was about 1 foot in length and rode home on his bicycle. An hour after the accident he began to complain of nausea, vomiting and abdominal pain. All of these symptoms increased in severity until the time the patient entered the hospital.

Physical examination after admission disclosed a temperature of 99.2°F., pulse rate of 138 and a respiratory rate of 20. The blood pressure was 106/78. The important physical findings included generalized abdominal tenderness and rebound tenderness, marked rigidity of the abdominal wall and absence of peristaltic sounds on auscultation. A small puncture wound, 1.5 cm., lateral to the left anal margin was seen.

Laboratory examination of the blood showed 4,650,000 erythrocytes, 20,200 leukocytes with 88 per cent polymorphonuclear cells and 9 per cent lymphocytes. The hemoglobin was 13.7 gm. The urine was normal.

Operation was performed one hour after admission. A left paramedian incision was made in the lower and mid-abdomen. One liter of brown, foul-smelling peritoneal exudate was aspirated. A rent was seen in the peritoneum of the rectovesical pouch, 4 cm. in length, just to the left of the midline. A loop of sigmoid overlying the perforation in the peritoneum revealed a perforation 8 mm. in diameter which was leaking bowel content. (Fig. 1.) This perforation was closed with three silk sutures. The descending colon was mobilized and a loop brought out through the abdominal incision. This loop was divided between two forceps which were left on the ends of the bowel. The abdominal incision was then closed so that the proximal segment of the colon was exteriorized at the upper angle and the distal segment at the lower angle.

The perineal wound was then explored and débrided, and a soft rubber drain placed in it. Examination of the rectum by palpation and with the proctoscope disclosed a perforation in the left lateral wall 6 cm. above the anal margin, about 1.5 cm. in diameter. This perforation was not sutured.

Postoperative treatment included blood transfusions, continuous Wangensteen suction for three days and adequate intravenous fluids. The forceps on the ends of the exteriorized colon were removed on the second postoperative day. Intravenous sulfadiazine and intramuscular penicillin and streptomycin were administered. Tetanus antitoxin in a dosage of 3,000 units was also given. After four days the streptomycin and penicillin were discontinued and sulfadiazine was administered orally. Cultures of the peritoneal exudate showed Streptococcus hemolyticus, Staphlococcus aureus and Escherichia coli.

On the tenth postoperative day the patient went home from the hospital. The colostomy was functioning satisfactorily. The distal loop of the colon and rectum was empty and the perineal wound was healed. The rectal perforation was also healed.

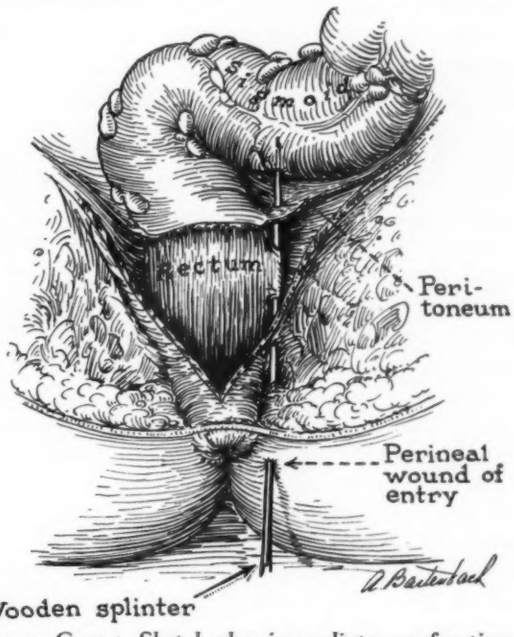

FIG. 1. Case 1. Sketch showing splinter perforating rectum and sigmoid.

Three months later, after the patient took sulfathalidine by mouth for ten days, the old abdominal scar was excised. The loops of colon were freed from the abdominal wall and the redundant portions removed. Intraperitoneal end-to-end anastomosis of the descending colon to the sigmoid was performed. The abdominal incision was closed without drainage and recovery was rapid and uncomplicated. On the seventh postoperative day the patient was discharged from the hospital. He has remained well since that time.

Case II. J. C., a ten year old white female, was admitted to St. Anne's Hospital on July 31, 1936. Two days before admission she fell on an iron picket fence and a picket penetrated the left side of the perineum for a distance of about 6 inches. This was followed by profuse bleeding which was treated by a physician. One hour later abdominal pain and vomiting were noticed but did not become severe. Nothing but water was taken by mouth for forty-four hours prior to admission.

Physical examination revealed tenderness in the left lower abdomen with peritoneal rebound tenderness. Moderate abdominal distention was also present. The leukocyte count was 18,000 and the temperature 99.2°F.

On the day after admission the abdomen was explored and a loop of small intestine (ileum) in the left lower abdominal quadrant presented a small perforation. A moderate amount of cloudy free fluid was noted in the peritoneal cavity. The perforation was closed and the abdominal incision sutured. The patient was discharged seventeen days after admission in good condition.

Case III. E. W., a ten year old white male, was admitted to Children's Memorial Hospital on October 21, 1938. Five hours before admission he fell in a hole about 8 feet in depth, impaling himself on an iron rod which entered the perineum to the left of the anus. He climbed out of the hole and went home. Subsequently, steadily increasing pain in the abdomen and vomiting were noted. Two hours after the accident he urinated and noticed fresh blood at the beginning of urination.

Physical examination revealed a temperature of 100.8°F., a pulse rate of 100 and a respiratory rate of 24. The abdomen was rigid over the lower portion, with maximal tenderness in the midline. A perforation about 5 mm. in diameter to the left of the anus was present. During the examination the patient urinated and most of the urine came from the perineal perforation although some came from the penis.

At operation shortly after admission a midline incision from the umbilicus to the symphysis was made and the abdominal cavity opened. The peritoneum was edematous. Exploration of the abdomen disclosed no intestinal injury. The bladder was then opened and bloody urine was seen. A jagged tear 3 cm. in length was observed in the left half of the trigonal area of the bladder. This was repaired with catgut. The bladder was closed around a mushroom catheter. Two Penrose drains were placed in the space of Retzius. Satisfactory recovery followed. At the time of discharge, thirty-one days later, the peritoneal and abdominal wounds were healed.

Case IV. M. B., a nine year old white female, was admitted to Children's Memorial Hospital on August 30, 1943. Four and a half hours before admission she fell from a tree landing on some bushes. A wide laceration between the rectum and vagina was sustained. Persistent lower abdominal pain followed the accident.

Examination disclosed a gaping perineal wound 5 cm. in length from which dark blood exuded. The lower abdomen was tender and rigid and bowel sounds were diminished in intensity and frequency. The urine contained no blood.

At operation one hour after admission of patient the abdomen was opened through a lower midline incision. No intestinal perforations were discovered. A ragged laceration in the peritoneum of the pouch of Douglas and a moderate amount of bloody fluid in the lower abdomen were seen. This was sutured with fine chromic catgut and the abdomen was closed. The perineal wound was loosely sutured with chromic catgut. Some drainage from the perineum was noted during convalescence. Healing was complete and the patient was discharged three weeks after injury.

Case V. D. K., an eight year old white female, was admitted to Children's Memorial Hospital on September 12, 1941. Two and a half hours before admission she fell astride a pointed fence. Laceration of the perineum followed by the loss of one-half cup of blood occurred.

At operation a second degree perineal tear into the vagina in the midline was present. The levator ani muscles, subcutaneous tissues and vaginal mucosa were sutured with fine catgut. Uninterrupted recovery followed and she was discharged one week after the accident.

Case VI. J. B., a four year old white female, was admitted to Children's Memorial Hospital on July 6, 1947. Shortly before admission she fell on a picket fence and suffered a laceration through the posterior vaginal wall, perineal body, internal anal sphincter and rectum. The rectal perforation was 1.5 cm. in length.

At operation the rectal mucosa was closed with interrupted sutures of fine chromic catgut. The internal sphincter, perineal body, vaginal mucosa and subcutaneous tissues were then closed after changing instruments and gloves. Primary healing followed and eight days later she was sent home.

COMMENTS

The six patients described herein, all under fifteen years of age, represent an incidence of two impalement perforations in 101,659 admis-

sions to a general hospital and four impalement injuries in 51,427 admissions to a children's hospital. Fortunately no deaths resulted in these cases although four patients were seriously injured.

Although extraperitoneal impalement injuries are usually not particularly severe as is shown by Cases v and vi, the patient in Case iii, representing an extraperitoneal penetration of the bladder, was seriously injured. The extraperitoneal wounds involving the rectum and perineum are best managed, according to Blaisdell,[1] by saucerization and open drainage without suture. These principles were applied to the management of the perineal and rectal wounds in Case i, with subsequent rapid healing. However, Cases v and vi, closed primarily soon after injury, also healed rapidly without infection.

Intraperitoneal perforations of the colon and rectum may be sutured but it is also necessary to establish proximal colostomy. It may also be advisable to perform proximal colostomy in extensive injuries to the extraperitoneal rectum. Experience acquired during the recent war by various surgeons proved the value of proximal colostomy but complete agreement as to the best type to perform is not evident from the publications on this subject.[6,11,18,19,25] A completely divided colon with the two ends separated, such as was used in Case i, produced satisfactory diversion of the fecal current.

In all impalement injuries it is extremely important to determine whether or not an intraperitoneal viscus has been penetrated. This cannot be done in the period immediately following injury because signs of peritonitis are usually not apparent, even if a viscus has been perforated. Failure to recognize the importance of careful and continued observation may be costly to the patient. In Case i the twenty-four-hour interval between the time of injury and definitive treatment was a cause of great concern, particularly because the patient had been examined by a physician soon after the injury. Apparently the possibility of an intraperitoneal perforation was not considered. Pearse[14] stated that a delay of seven or more hours was invariably fatal in instrumental perforations of the rectosigmoid. Shidler[18] as a result of experience gained with perforations of the colon during warfare stated that injuries older than eighteen hours produced fatal peritonitis. Fortunately, in spite of the long delay before institution of treatment in Case i recovery occurred.

Consideration of the various case reports which have been published dealing with impalement perforations of the perineum makes it apparent that many unusual injuries and combinations of injuries have occurred. Probably no proposed method of management will include all possible problems which might arise. Nevertheless, the method of management outlined herein should aid in avoiding errors of omission.

In the six cases described herein all patients recovered. Four of them were injured seriously; intraperitoneal perforations occurred in three and an extraperitoneal rupture of the bladder was sustained in the fourth case. Only one patient (Case i) received antibiotic and chemotherapeutic drugs. However, it is quite likely that these substances will reduce the mortality from peritonitis following impalement perforations.

SUMMARY

1. Six patients with perineal impalement perforations, all of whom recovered, are described in this report.

2. The importance of admission to a hospital and proper examination of a patient with an impalement injury, particularly in the period immediately following injury, is stressed.

3. Whether or not an intraperitoneal viscus has been penetrated is the primary consideration in the management of impalement injuries of the perineum.

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In 1875 Paget described a condition causing a swollen arm which he thought might be due to interference with the circulation. Nine years later Schrotter described a similar case and thought injury to the axillary vein with formation of a thrombus was the etiologic factor. Recently, however, E. S. R. Hughes described several cases and offered evidence tending to prove that the phrenic nerve as it passes anteriorly to the subclavian vein can tightly compress this vein against the tendon of the scalenus anticus and produce this swollen arm in individuals who are otherwise entirely healthy. Unless anticoagulants are given at once, intravascular clotting may result and this may even interfere with the establishment of an adequate collateral circulation. Paravertebral sympathetic blocks should also be performed promptly because of the favorable influence that they have in relaxing vasospasm and thus in promoting an adequate and timely collateral circulation. (*Richard A. Leonardo, M.D.*)

NEUROGENIC OSSIFYING FIBROMYOPATHIES*

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OSSIFICATION of the capsule and neighboring structures in the region of joints has been reported to occur in 39 per cent[7] to 44 per cent[1] of spinal paraplegics. The phenomenon is one of many oddities found in medicine and one of three pathologic changes that may occur in paraplegic extremities. The other two are osseous and muscular atrophy and osteoarthropathies of the Charcot type.

The lesions of this affection are characterized by the formation of a mature, trabeculated, spongy type of bone in the joint capsule and tendons in the region of the capsule, marked osteoporosis of the neighboring long bones and the preservation of the cartilaginous surfaces of the joint as well as the preservation of the joint space.[3] The involved joints are always below the level of the cord lesion but the degree of trauma to the cord and other parts of the body bears no relationship to their extent or formation.[7] Once formed these calcifications are permanent. Return of function to the paralyzed limb does not influence resolution of the osseous deposits.

The pathomechanics are not definite. Varied opinions have been expressed. It is generally accepted that the mobilization of calcium, seen in paraplegics, plays an important role. From here, things are far less understood. Abramson[1] is of the opinion that pressure over the involved joint is the stimulating factor. Roache and Jostes[6] believe that lack of early mobilization is the precipitating cause. Freeman[4] presents the theory that the phenomenon could be explained on the basis of low grade infection, because in his cases decubiti were found over or in juxtaposition to involved joints. He surmized, when not in direct association, the infection traveled down fascial planes to neighboring joints. His group has been able to culture organisms from the centers of calcification. Brailsford[2] does not try to explain the etiology but mentions how the paralytic limb in his case became edematous and then the calcium in the region of the elbow was noted. This observation was similar to one made in one of our cases.

Fig. 1. Case 1. Reveals calcification early on both the flexor and extensor surfaces; the joint margins appear to be uninvolved.

Since the cause of development is not definitely known, a direct approach to the handling and prevention of such lesions is difficult. Several authors have shown that early mobilization will minimize their formation, but as our first case report shows, will not prevent them.[1,5,6,7] For this reason, and because only two other cases involving the upper extremity have been previously reported and none with bilateral or small joint involvement or with a long period of follow-up, the following two cases are submitted:

CASE REPORTS

Case 1. R. M., a forty-eight year old white male, was admitted to Kings County Hospital, neurosurgical service on April 11, 1948. On admission he stated that on the previous night, after having a few drinks, he fell down one flight

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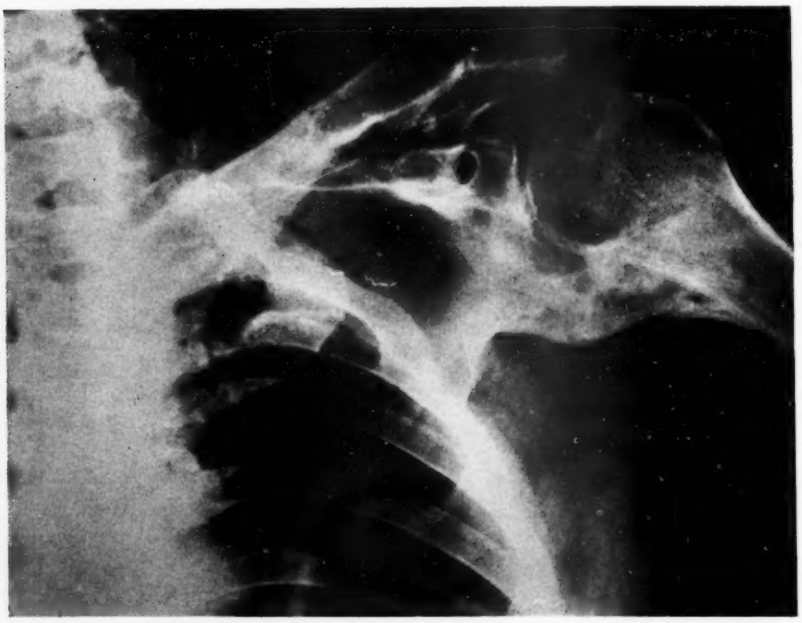


FIG. 2. Case 1. Reveals the presence of calcific deposits in axillary portion of humerus and scapula producing scapulohumeral fusion.

of stairs. Members of his household then carried him to bed. The next morning upon awakening he felt pain in both shoulders and was unable to move either arm and also noticed numbness of both legs and an inability to void. The rest of his history was essentially negative.

Physical examination revealed a well developed and well nourished male in no acute distress whose physical findings were negative except for moderate paresis of the upper extremities and mild paresis of the right lower extremity. The deep tendon reflexes were all suppressed in the upper extremities but active in the lower extremities, and a positive Babinski was present on the right. Dysesthesias and hypalgesias were present from the level of the shoulders down. A No. 128 tuning fork was appreciated from the illiac crests caudally but not above. X-rays of the cervical spine were negative for fracture or dislocation. A diagnosis of cord trauma was made and the patient was placed in Crutchfield tongs and on tidal drainage.

Within a few days full activity of both lower extremities was present. Four days after admission physiotherapy in the form of heat and active and passive motion of both upper extremities was started and performed daily except over weekends. Three weeks later both hands were edematous and required continuous elevation. Skull traction was continued until the sixth week when it was removed and ambulation started with the patient wearing a cervical collar. No decubiti developed around the involved limbs during this period of recumbency.

Nine weeks after admission occupational therapy in the form of a pedal type of jigsaw and sanding were added to the physiotherapy which the patient was already receiving. Several days later because of failure of improvement of active and passive motion in the upper extremities the elbows were x-rayed. On July 13th, ninety-three days after admission, it was reported that both elbows were ankylosed. (Fig. 1.) At this time the patient was transferred to the orthopedic service and it was noted that the elbows were fixed at 145 degrees and the wrists at 180 degrees. There was no active motion in any of the fingers except the thumbs. These could be opposed to the index fingers. There were 25 degrees of abduction and flexion in both shoulders, but all movements were scapulothoracic. The entire upper extremities were smooth, shiny, moist and edematous. X-rays revealed osseous deposits around the joints of both upper extremities. (Figs. 2 and 3.) The blood count, urine and blood chemistries were all within normal limits. The blood calcium was 11.9 mg. per cent, the phosphorus 4.7 mg. per cent and the alkaline phosphatase 6.7 units (Bodansky).

Physio and occupational therapy were continued with no appreciable improvement. On October 14, 1948, six months after admission, in an attempt to improve function of the extremity, the right elbow was resected. The wound healed primarily and active motion was started in two weeks postoperatively. Grossly, the cartilaginous surfaces were intact. The joint space was present and the capsule had been replaced by a spongy type of bone. (Fig. 4A and B.) The elbow improved slowly until he could extend it to 160 degrees and flex it to 80 degrees by March, 1950, but no improvement in associated joints or resolution of calcium were present.

In a further attempt to increase the function of his right arm the outer one-third of the right clavicle was resected. He improved slowly and the tone of the arm muscles gradually increased, but he was still unable to feed himself or take care of his personal needs.

In October, 1950, while further reconstructive procedures were under consideration, the patient developed blood-streaked sputum and on November 1st his sputum was reported as being positive for acid-fast organisms. He was transferred to another hospital in which further investigation did not corroborate the diagnosis.

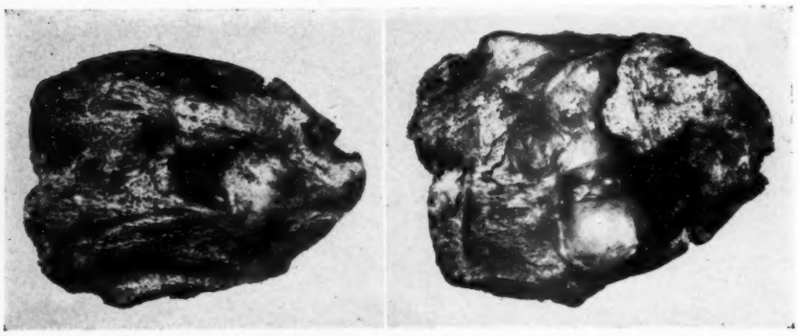
At the time of transfer he was able to flex his right shoulder girdle to 60 degrees and abduct to 90 degrees, the motion still being scapulothoracic. The right elbow would extend to 180 degrees and flex to 80 degrees. He was able to touch the back of his head and make the sign of the cross. The right wrist had no dorsiflexion but would volar flex to 60 degrees. Ulnar and radial deviation were possible. Full motion of the metacarpophalangeal joint of the thumb was present. Metacarpophalangeal motion was present in all except the third finger. There was no interphalangeal motion. The left shoulder girdle was partially frozen with only 25 degrees of flexion and abduction; the elbow was frozen completely and the wrist could be dorsiflexed 15 degrees and volar flexed 90 degrees. The thumb motion was good but three fingers lacked metacarpophalangeal motion. The interphalangeal joints were frozen.

FIG. 3. Case 1. Calcification is noted at metacarpophalangeal joints of third, fourth and fifth digits and also at the proximal interphalangeal joints of second, third, fourth and fifth fingers.

CASE II. The chart of the original admission was unobtainable so that the following data is from existing records and from the patient:

F. R., a forty-two year old white male, was admitted to Kings County Hospital, neurosurgical service on December 24, 1936, with the history that he had fallen down a flight of stairs landing on his head and neck. On admission he was unconscious and had sustained a laceration of the scalp and a fracture of the skull. No definite trauma to the cervical cord was noted on admission, but several weeks later when he gained contact with his environment he noted weakness of the right arm and paralysis of the left hand. It was assumed then he had sustained injury to his cervical cord. At this time the patient noted that he was unable to bend his right elbow. He was then transferred to the orthopedic service and a diagnosis of traumatic ankylosis of the right elbow was made. Since it was in a functionally good position, no further therapy was considered.

At the present time the right elbow is fixed at 135 degrees. Full range of motion is present in all other joints of both upper extremities. The patient states that he can perform all his daily needs but has held no steady employment



4A 4B

FIG. 4. Case I. Photographs of resected elbow joint. A, note calcification around joint with major portion on the extensor surface (posterior view); B, note preservation of the joint space and articular surfaces (anterior view).

FIG. 5. Case II. Note marked deposition of calcium in antecubital region; also, note trabecular formation in deposit and retention of the joint space.

since his injury. The x-ray of the right elbow demonstrated periarticular ossification with preservation of the joint space. (Fig. 5.)

COMMENTS

These two cases demonstrate that the involvement is completely extra-articular and that mobilization of neighboring joints with return of muscle power does not promote regression of the lesions. The first case shows how small joints, where pressure is minimal, are also involved and that even with early mobilization the lesions may occur. It also demonstrates that associated decubiti or other ports of entrance for infection do not necessarily have to exist for the formation of the lesions. The second case demonstrates that after fourteen years the lesions can still exist with the joint space preserved.

The first case illustrated marked sympathetic changes resembling those seen in rheumatoid arthritis, poliomyelitis and trauma. The relationship of this to the formation of the calific deposits cannot be fully explained, but further study of this condition and its possible relationship to the collagen group of diseases and causalgias must be made. Also, it must be determined what effect cortisone and ACTH might have upon their prevention and treatment if there is any relationship to the collagen group.

CONCLUSION

Neurogenic ossifying fibromyopathies are still a medical mystery; but since they occur, all concepts concerning their origin must be considered and explored. The management of such cases is very difficult and other factors besides early mobilization must be considered and used in all paraplegics to prevent their occurrence. When such lesions occur, all forms of reconstructive procedures must be considered to convert the suffer into a self-sufficient and productive individual.

SUMMARY

1. A brief discussion of the characteristics and pathomechanics of neurogenic ossifying fibromyopathy has been made.

2. Two cases, one of bilateral involvement of the upper extremity and one with a fourteen year follow-up, have been presented.

3. The possibility of this process being related to the collagen group of diseases or the causalgias is mentioned.

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DISSECTING ANEURYSM SIMULATING LARGE BOWEL OBSTRUCTION*

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THE purpose of the present communication is to report a case of dissecting aneurysm of the aorta which presented a fairly typical clinical and radiologic picture of large bowel obstruction.

Dissecting aneurysm is an uncommon occurrence but more frequent than generally realized. Eliason and McNamee[5] reported twenty-four cases in 200,000 admissions, and David and colleagues[4] reported an incidence of one in 635 autopsies. The average age in the latter series of cases was fifty-nine and the disease was found to be two to three times more common in males than in females. Baer and Goldburgh[1] indicated that this condition could probably be diagnosed more frequently if the index of clinical suspicion were higher. Although pain, fever and tachycardia were stressed by these authors as common symptoms of dissecting aneurysm, they also noted the well known protean manifestations of the disease. Melena and hematemesis may occur, if the celiac axis or mesenteric vessels are involved, simulating bleeding peptic ulcer. Other cases have been reported[2,5] which presented a clinical picture suggestive of esophageal varices, carcinoma of the esophagus, cholecystitis, mesenteric thrombosis and pancreatitis.

A dissecting aneurysm may develop on a basis of either syphilis or atherosclerosis, but arterial hypertension and cardiovascular disease are noted in every case.[4] A paralytic ileus may occur in association with the development of this condition, but it is not generally recognized that dissecting aneurysm may suggest a clinical diagnosis of obstructive lesions of the gastrointestinal tract. Warren and McQuown[6] stated: "Extraperitoneal rupture of dissection into the mesenteric arteries may simulate intrinsic disease of the gastrointestinal tract. Symptoms suggestive of mesenteric thrombosis, ileus, malignancy of the bowel or hernia may confuse the examiner and lead to surgical intervention." They reported one case with abdominal pain, nausea and vomiting, diagnosed clinically as carcinoma of the stomach, and another case with pain in the right lower quadrant and bloody diarrhea, diagnosed clinically as strangulated hernia. A third patient with increased peristalsis, distention, tenderness and rigidity was operated upon because of the presence of an associated incarcerated inguinal hernia, but the obstructive signs were found to be due to intestinal ischemia secondary to a dissecting aneurysm.

Shelley[7] reported the case of a seventy-three year old white male in whom the development of an aneurysm of the descending aorta was accompanied over a period of two months with progressive distention and constipation. A barium enema showed tremendous distention of the colon but no obstruction, and the intestinal stasis was subsequently relieved by anal dilatation. Large bowel obstruction was diagnosed by Van Meurs[8] in a sixty-five year old male complaining of severe upper abdominal pain of sudden onset which radiated through to the back, followed with marked distention not relieved by enemas; the correct diagnosis of dissecting aneurysm was made later when an abnormal pulsation was felt just to the left of the umbilicus. A sixty year old male suffering with intermittent abdominal pain, marked distention, bloody diarrhea and vomiting of six days' duration was diagnosed by Cuny[3] as having volvulus of the pelvic colon, and was subjected to operation. A ruptured aortic aneurysm was found and death occurred on the following day. So far as is known to the author no other cases simulating large bowel obstruction have been reported.

CASE REPORT

W. M., a forty-eight year old colored male, was admitted to the Roper Hospital July 10, 1950. Five days previous to admission a con-

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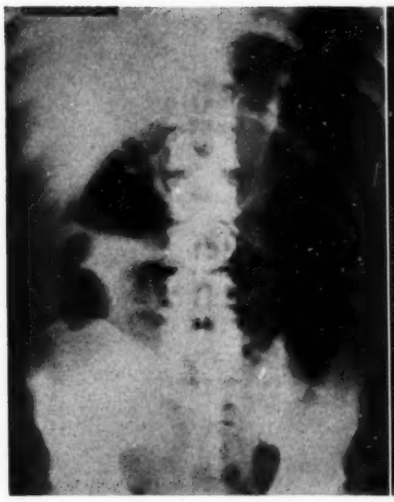

FIG. 1. Flat film of abdomen, July 10, 1950.

FIG. 2. Barium enema, July 11, 1950.

FIG. 3. Post-evacuation film, July 11, 1950.

stant epigastric pain suddenly developed which was somewhat aggravated by meals and which occasionally radiated through to his back. The pain persisted until the time of admission and on several occasions was accompanied with nausea; however, he had not vomited. During the five-day period he had two watery bowel movements, the last one on the day before admission. There was no history of bloody or tarry stools, or change in size of the stools. He had not passed flatus for eighteen hours before admission. There was no history of weight loss. The patient had been in excellent health prior to this episode. His review of systems was essentially negative and his past history not remarkable except that he had taken "about twenty hip shots" in 1943.

On examination the patient was well developed and nourished. His temperature was 99°F., pulse 92, respiration 20 and blood pressure 220/150. The abdomen was rounded, moderately distended and tympanitic except in the hypogastrium. No tenderness, rebound tenderness or involuntary spasm was elicited and there were no palpable masses. Peristaltic sounds were moderately hyperactive. Rectal examination was negative except for moderate diffuse prostatic enlargement. His optic fundi showed early arteriosclerotic changes. Physical examination was otherwise negative.

His red cell count was 4.1 million, with 12 gm. of hemoglobin, a leukocyte count of 7,000 and a normal differential smear. Urinalysis was reported as follows: specific gravity 1.021, acid, 2+ albumin, sugar and acetone negative, 8 to 10 white blood cells per high power field, 5 to 8 red blood cells per high power field and no casts. The Wassermann and Kline tests were negative, urea nitrogen 15 mg. per cent, blood chlorides 435 mg. per cent, CO_2 combining power 62 volumes per cent, serum potassium 16.9 mg. per cent and serum sodium 350 mg. per cent.

A flat film of the abdomen at the time of admission (Fig. 1) showed marked distention of the entire large bowel down to the mid-sigmoid region, suggesting obstruction at that point. There was no gas in the rectum or terminal sigmoid. Several loops of slightly dilated small bowel were also noted. A Miller-Abbott tube was passed into the duodenum and during the night was allowed to pass on down into the lower reaches of the small bowel. On the following day because there was very little change in the clinical picture proctoscopy was performed.

The instrument was easily passed to the 9 inch level, and at that point a constriction of the lumen was noted but no mucosal ulceration or other lesion was seen. A barium enema was given and the first film (Fig. 2) showed a markedly distended colon filled with barium. The postevacuation film, however (Fig. 3), showed the colon to be fairly well constricted; it was noted that a large quantity of gas had been evacuated with the barium.

The patient improved somewhat following the barium enema but two days later his abdomen was again distended and tympanitic and he complained of pain. A barium enema

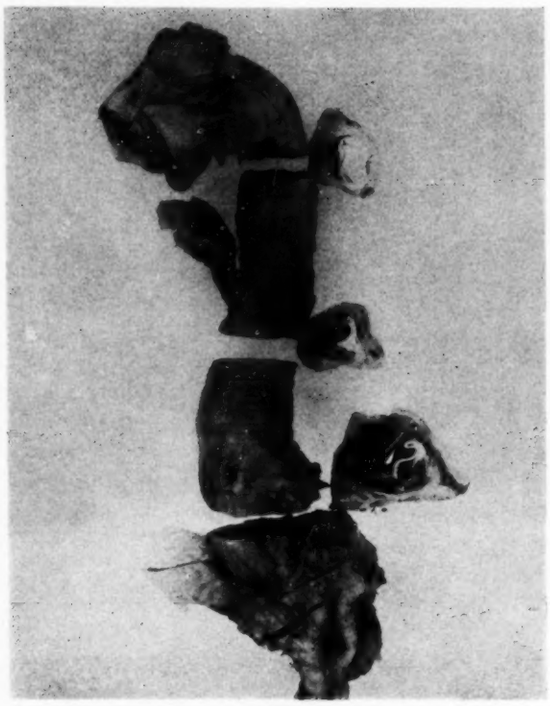

FIG. 4. Autopsy specimen of aorta sectioned at intervals to show dissection.

was given again, with results identical to those of the first examination including temporary deflation. His temperature during the hospital stay ranged from 98.6° to 101°F. On July 15th the Miller-Abbott tube was clamped off, and since distention did not immediately recur, the tube was removed the following day. The patient continued to pass flatus but complained of vague, intermittent, left-sided abdominal pain radiating through to the back. Proctoscopy on July 17th revealed that the area of constriction at the 9 inch level had disappeared and no abnormality was noted. Distention did not recur and the patient was given a regular diet. A chest film showed no abnormality except for mild left ventricular hypertrophy and some elongation and tortuosity of the thoracic aorta. An upper gastrointestinal series on July 19th failed to demonstrate any abnormality. On July 20th the patient suddenly fell from his chair to the floor, crying out, and after gasping for breath a few minutes, died despite heroic efforts to resuscitate him.

Postmortem examination demonstrated about 600 cc. of partially clotted blood in the left pleural cavity and a displacement anteriorly of the left posterior parietal pleura by a large clot of blood. The abdomen contained about 100 cc. of blood-tinged fluid. The descending aorta was involved in a dissecting aneurysm down to the point of origin of the inferior mesenteric artery. (Fig. 4.) Distal to this point the aorta was markedly constricted. The aneurysm had ruptured in its upper segment resulting in retropleural hemorrhage. No obvious changes were noted in the bowel. Nothing of special interest was observed microscopically except for the presence of arteriolar and arteriosclerosis.

COMMENTS

The sudden onset of obstructive symptoms in a previously healthy, well nourished, relatively young individual immediately suggested that the disease was probably not carcinoma of the large bowel. Volvulus of the sigmoid was the first diagnosis considered, and it was thought that the deflation following barium enemas was due to reduction of the volvulus. Nevertheless, the x-ray picture was never typical of volvulus. The patient's sudden death suggested the correct diagnosis of ruptured dissecting aneurysm. The intermittent episodes of pain, distention and obstruction may be explained as being the result of intermittent ischemia of the bowel secondary to the dissecting aneurysm.

If the index of clinical suspicion had been higher with regard to dissecting aneurysm, the sudden onset of abdominal pain, radiating to the back and accompanied with obstructive signs and fever, might have suggested the correct diagnosis.

SUMMARY

A case of dissecting aneurysm of the aorta with symptoms and signs of large bowel obstruction and death resulting from rupture has been presented.

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Formerly only about 10 per cent of the cases of cancer of the prostate were operable. Now by the use of preliminary hormone therapy (diethylstilbestrol, usually, castration or corpus luteum therapy) practically all but the scirrhous types (25 per cent of all cases) of cancer of the prostate become operable—an important advance. Ultimate cures, therefore, are increasing from the original 5 per cent of all cases to 50 per cent or 60 per cent of all cases rendered operable by this temporary metamorphosis of the metastases and original cancerous growth in the prostate that has been induced by adequate hormone therapy. The diseased prostate may be radically removed by various operations. A very successful one is the procedure wherein the whole prostate, together with both seminal vesicles, is removed perineally and the membranous urethra is then anastomosed to the neck of the bladder. In this operation the surgeon must not forget to plicate Denonvilliers' fascia and thus prevent urinary leakage by reinforcing the closure of the prostatoperitoneal aponeurosis. (*Richard A. Leonardo, M.D.*)

IRREDUCIBLE GANGRENOUS INTUSSUSCEPTION*

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THE following report is one of the few in the literature of recovery following resection for irreducible intussusception under the age of one. It also serves to illustrate the danger of error in the barium enema method of diagnosis and the hydrostatic pressure method of reduction of intussusception.

CASE REPORT

M. J. C., a six month old white male, was referred to our hospital on February 18, 1946, with the complaint of vomiting, crying at intervals and bloody stools for fifteen hours. For seven hours the parents had noticed a hard mass in the left side of the patient's abdomen.

On physical examination the temperature was 99°F., pulse 30 and respiration 22. The patient was well developed and nourished and was lying on his back in no apparent distress except at intervals when he would roll from side to side, draw up his hands and feet and scream out apparently in pain. A palpable mass to the left of the umbilicus was noted when the abdomen was relaxed between intervals of colic. On rectal examination the mass could not be palpated but a bloody currant jelly stool on the examining finger was noted. The remainder of the physical examination was non-contributory.

A diagnosis of intussusception was made and a barium enema was done for confirmation. Following the barium enema the mass disappeared and fluoroscopic examination showed apparent filling of the entire colon.

A diagnosis of reduced intussusception was then made since the mass was gone, the patient was sleeping quietly, stopped vomiting and had no more bloody stools. Apparently reduction had been effected by hydrostatic pressure of the barium enema. As this is a method of treatment advocated by some authorities[1,8,9,17] it was thought safe to observe the patient further.

Eleven hours after the reduction the patient vomited some yellowish fluid but during that day there were no other complaints and the patient received atropine 1/500 gr., sodium phenobarbital 1/4 gr. and 200 cc. of normal saline by hypodermoclysis every four hours. The abdomen remained soft, the patient rested, there was no colic, no bloody stools and rectal examination was negative. The second day in the hospital all medications were discontinued and a 3-ounce formula was administered every four hours and retained. A small amount of pink chalky stool was obtained that day. On the third day the patient vomited a large amount of the 6 A.M. feeding and a blood-stained chalky bowel movement was obtained that night. During the night a small amount of formula was regurgitated. The morning of the fourth day the patient vomited a large amount. By noon the patient became extremely restless and vomited at intervals. It was noticed that the abdomen had become distended. No masses were palpable, abdominally or rectally, although blood was noticed on the examining finger. Because of the vomiting, distention, restlessness and bloody rectal examination, an erect plate of the abdomen was taken which revealed marked fluid levels and accumulation of gas. (Fig. 1.)

This was then followed with a barium enema which showed the barium reaching only as far as the splenic flexure. (Fig. 2.)

A diagnosis of unreduced intussusception was made and it was elected to open the patient's abdomen.

While preparation was being made for surgery, a 200 cc. normal saline hypodermoclysis was given. A gastric tube was inserted, the stomach was emptied and the tube left indwelling. One hour following premedication of atropine 1/500 gr. by hypodermic, open drop ether was administered. The abdominal wall was infiltrated with 0.5 per cent procaine solution in the right transrectus plane just above the umbilicus. The abdomen was opened through a transverse incision, dividing the right rectus muscle. The ether anesthesia was discontinued and the remainder of the operation

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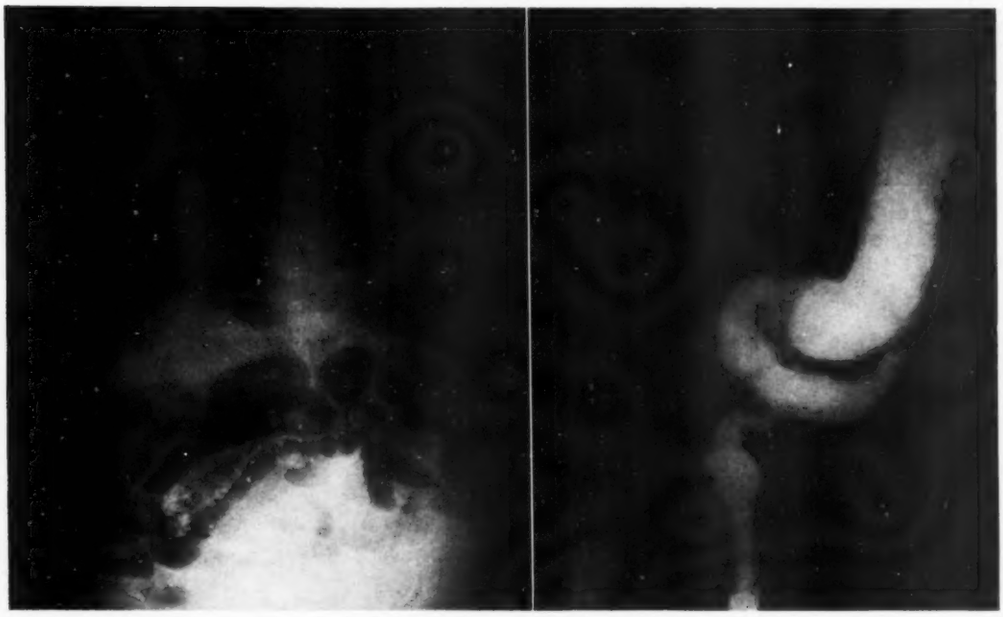

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FIG. 1. Erect plate of the abdomen shows marked fluid levels and accumulation of gas indicative of intestinal obstruction.

FIG. 2. Examination shows the barium by means of enema reaching as far as the splenic flexure.

was performed under local anesthesia. A mass of intussuscepted bowel was palpated in the region of the transverse colon extending to the splenic flexure. Reduction progressed satisfactorily until the hepatic flexure was reached, at which point reduction became very difficult. Inserting the little finger between the entering and ensheathing layers somewhat reduced the mass. Then sponge-holding forceps to stretch the intussuscipiens were used but the serosal coat became lacerated. Forcible pressure reduction was used as a last resort. This reduced the intussusception with the exception of the base of the appendix and ileocecal portion of the intestine. Insertion of an instrument between the entering and ensheathing layers revealed a gangrenous perforation at the ileocecal junction. Careful examination revealed several areas of early gangrene of the ascending colon and thrombosis of the ileocolic vessels which was subsequently confirmed by pathologic examination.

The terminal 3 inches of ileum, the cecum, ascending colon and right half of the transverse colon were resected. Then an open end-to-end anastomosis between the ileum and the transverse colon was done. The incision was closed in layers with interrupted sutures of No. 50 white spool cotton.

Postoperative supportive therapy was used in the form of oxygen and intravenous fluids including blood, plasma, glucose and saline. Continuous gastric suction was maintained for the first thirty-six hours during which time the patient had a normal brown pasty stool and showed no evidence of distention. Removal of the gastric tube was done as early as feasible to alleviate the danger of middle ear infection and aspiration pneumonia. The patient had an uneventful course except for development of thrush on the sixth day which was treated with local applications of 2 per cent gentian violet and cleared in forty-eight hours. Penicillin parenterally was used as a prophylactic measure in doses of 20,000 units every three hours until the eighth day for a total of 1,000,000 units.

Sutures were removed on the eighth postoperative day, there were no wound complications and the patient was discharged on the thirteenth day. This case has been followed in the outpatient clinic and was last seen four months later at which time the patient was gaining weight, his appetite was good and his bowels were normal. A barium enema was done at this time and the anastomosis was visualized and functioned well. (Fig. 3.)

This patient was last examined in July, 1951. He had grown into a well developed six year

old boy with normal bowel habits and well formed stools.

COMMENTS

Instances of recovery followed intestinal resection for irreducible intussusception have been very few. Dowd[4] in 1913 reported a successful resection in a five-day old infant. He collected seven other successful cases from the literature. Clubbe[2] found but nineteen survivals under one year by 1921. Southam and Crawshaw[18] in 1921 reported two recoveries following resection; in one case the abdomen was opened and in the other an external resection of the prolapsed intussusception was accomplished. Perrin and Lindsay[16] in 1921 reviewed 400 cases treated at the London Hospital and did not find a single example of survival after resection when the child was below the age of three years. According to Ladd and Gross[12] the mortality rate in babies under one year of age is 75 per cent or more. Of a large series of cases treated for intussusception they report forty-three resections with ten recoveries, three of which were combined with anastomoses and seven of which had a double enterostomy (Mikulicz's procedure). Wangensteen[21] in 1942 reported a recovery following a stage resection in a four month old infant. He recorded two other cases of recovery, Dennis' case of a primary aseptic resection of the terminal ileum in a two month old infant and Alberts' successful primary resection with an open anastomosis in a newborn infant. From Britain comes the report of Hindmarsh, Stewart and Morrison[7] of two cases of stage resection with survival of infants, one eight months and the other five months of age. From the Ford Hospital Fallis and Warren[6] report two cases of successful primary resection of irreducible intussusception in infants, one eight months and the other five months of age.

The foregoing case is of interest not only because of its rarity but also because of the several questions it brings up for consideration. These are as follows: (1) the value of barium enema in the treatment of intussusception; (2) operative versus non-operative treatment of intussusception; (3) procedure when confronted with irreducibility and gangrene.

VALUE OF BARIUM ENEMA

Barium enema is an aid in the diagnosis of intussusception but it is not absolutely essential, a negative barium enema does not necessarily rule out the condition, certain cases produce positive x-ray evidence that may be mistaken for intussusception and barium enema is not without danger.

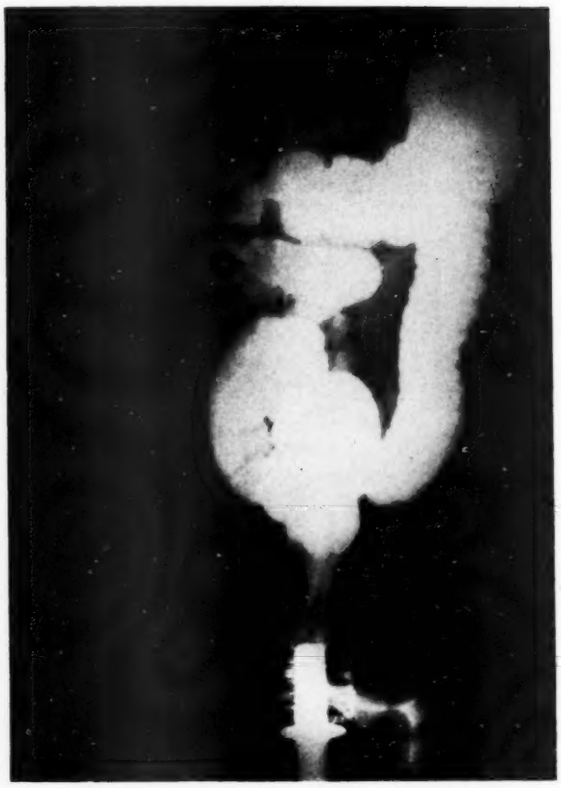

FIG. 3. Postoperative barium enema shows the barium filling the remaining portion of the colon and passing readily into the small intestine, the loops of which are considerably distended with the barium. The site of anastomosis between the large and small bowel is in the mid-portion of the transverse colon.

The presence of the four cardinal symptoms, namely, colic, vomiting, bloody mucous stools and a palpable abdominal tumor almost confirm the diagnosis. In typical cases, however, x-ray evidence may be of great value as a filling defect becomes apparent in the colic, ileocolic and ileocecal varieties. An evaluation of the roentgen criteria of intestinal invagination was made by Kirsner and Miller.[11] They reported that the most frequent signs of invagination are obstruction to the barium with a filling defect, mobility of the obstruction under manipulation, palpable mass and the passage of barium between the intussusceptum and intussuscepiens.

A negative barium enema does not completely rule out intussusception as the enteric

variety usually gives no information by this means. Kirsner and Miller[11] mentioned the use of the barium meal in order to pick up the enteric variety.

Positive x-ray evidence even combined with clinical evidence is not infallible. Kirsner and Miller[11] mention a case of carcinoma of the hepatic flexure of the colon, with partial bowel obstruction which was preoperatively diagnosed as intussusception in an adult male. Retan[17] mentioned a case of a nine month old infant presenting vomiting, bloody stools, a palpable abdominal mass and stoppage of barium at the transverse colon. It was diagnosed as intussusception. At surgery the patient had a volvulus of the ascending and transverse colon.

Barium enema may be dangerous for it may effect apparent reduction and lead to unnecessary delay in the operative treatment.

OPERATIVE VERSUS NON-OPERATIVE TREATMENT

The non-operative treatment of the intussusception does have its advocates. Hipsley[8,9] reports a consecutive series of 159 cases of intussusception treated by rectal injection of saline solution in which reduction occurred in 60 per cent. Retan[17] advocates a trial of taxis and barium enema under fluoroscopic control when the patient is seen in the first twelve hours. Wangensteen[19] has tried the method but apparently does not advocate it as he advises opening the abdomen in every case to confirm complete reduction.

It would seem that the possibility of incomplete reduction or of compound intussusception is too great a hazard even if the procedure is done with barium under fluoroscopic control. However, one might imagine its use on some frontier of civilization that is far removed from an operating table.

PROBLEM OF IRREDUCIBILITY AND/OR GANGRENE

The surgeon faced with an intussusception which cannot be reduced at operation has a grave problem on his hands. After all means of reducing the invagination have been used and one is sure that reduction is impossible, recourse must be taken to one of the following procedures: (1) An enterostomy or colostomy may be formed above the obstruction leaving the intussusception in the abdomen.[8,15] (2) The fecal stream may be shunted around the obstruction by a lateral anastomosis leaving the intussusception *in situ* and reinforcing the neck by sutures.[5,8,12,13,15] (3) A resection may be made through an incision in the outer layer as in the Coffey or Jessetts operation.[1,5,8,18] (4) Mikulicz resection may be done, making an artificial anus of the ends of the bowels.[7,19] (5) A resection with primary anastomosis.[4,5,6,19]

Operations which leave the intussusception *in situ* make use of the tendency of spontaneous cure by sluffing and elimination of the gangrenous intussusception.[14] However, this leaves a gangrenous intussusception as a possible source of peritoneal infection or severe intestinal hemorrhage. Resection through an incision in the outer layer is technically difficult, exposes the patient to sepsis at the time of operation and stenosis at the neck may later occur. Any operation in which an enterostomy or colostomy is formed in a child is highly objectionable on the basis that intestinal fistulas are poorly tolerated in infants and children because of rapid dehydration, electrolyte imbalance, wound infection and difficulty in caring for the fistula. The objection to primary resection with immediate restoration of the bowel continuity has been its very high mortality rate. But the alternatives to primary resection present the aforementioned anatomic and physiologic objections and have an equally high if not higher mortality rate. According to Ladd and Gross,[12] " . . . the successful resections for intussusception which could be gathered from the literature were treated in the majority of instances by primary anastomosis of the intestine." This operation seems to be ideal as it accomplishes the double objective of removing the gangrenous intestine and relieving the obstruction.

Because a successful case of primary resection is reported, there is no reason that this procedure should be advocated in all irreducible cases of intussusception. The choice of procedure which offers the best chance of recovery must be determined by individualization of each case. A short circuit, merely to relieve the obstruction, seems to be good judgment in the very poor risk subject. However, in fairly good risk patients, and here is when individual judgment enters, a primary closed resection, as advocated by Dowd[4] as far back as 1913, is the ideal procedure. In addition, it is proposed for consideration that primary resection with anastomosis may be the procedure of choice in all cases of irreducible and/or gangrenous intussusception. This proposition

must be proved by review of case reports of failures as well as successes.

SUMMARY

1. A successful case of primary resection for irreducible gangrenous intussusception under the age of one is reported.

2. The literature reveals very few other such recoveries.

3. This case also brings up the careful consideration of barium enema diagnosis of intussusception, operative versus non-operative treatment and procedure when confronted with irreducibility and gangrene.

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CYST IN THE LIGAMENTUM TERES OF THE LIVER*

REMNANT OF THE UMBILICAL VEIN

JOHN E. KARABIN, M.D.
Colorado Springs, Colorado

THE fetal left umbilical vein situated in the falciform ligament of the liver normally obliterates at birth to form the ligamentum teres hepatis in the adult. Failure of obliteration results in a cyst in the ligament as found in the following case presentation.

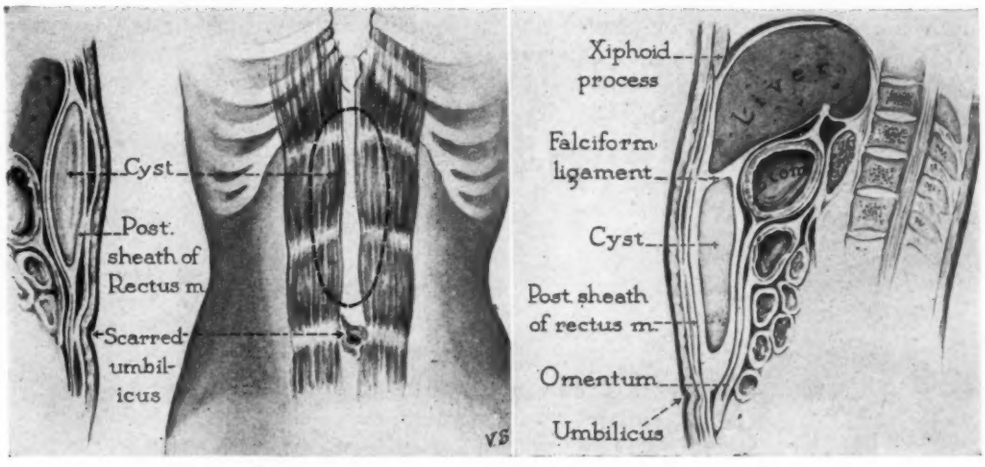

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FIG. 1. Diagrammatic illustration of the position of the residual cyst in the ligamentum teres of the liver.
FIG. 2. Sagittal section illustrating the relationship of the cyst in the falciform ligament to other abdominal organs.

There is no evidence in the literature of any similar case.

CASE REPORT

Mrs. W., aged twenty-four, was seen in July, 1947, complaining of pain in her upper abdomen of six weeks' duration. She presented a history of having been struck in the upper abdomen with the handle of a lawnmower. Since this injury there had been a persistent gnawing pain associated with nausea and vomiting. She was seen by a physician who immobilized her chest and stated that she had a fractured rib. No x-ray examination was made to prove this diagnosis. There was no improvement with this treatment.

Upon examination of the patient there was diffuse tenderness between the xiphoid process and the umbilicus. Upon percussion a dull mass could be elicited in the midline. The mass was fixed to the anterior abdominal wall. The umbilicus was quite deformed from previous surgery. The patient stated that she had a partial eventration of the intestines through the umbilicus at birth which was repaired without complication.

The patient's temperature was 98.6°F., the pulse rate 98 and the leukocyte count 8,000. The preoperative diagnosis was a possible epigastric hernia or a simple contusion of the abdominal wall with an associated hematoma. She was advised to use heat for several days and if the pain and vomiting persisted it would be necessary to investigate the lesion surgically.

After several days the patient returned with more pain and vomiting. She was admitted to the St. Francis Hospital and explored under spinal anesthesia. The lesion was found to be a large, fusiform, cystic mass measuring 6 inches in length, 2 inches in width and 3 inches in

* From the Department of Surgery, Colorado Springs Medical Center, Colorado Springs, Colo.

depth. (Fig. 1.) The cyst was filled with serosanguineous fluid. The lining of the cyst was hemorrhagic. The roof of the lesion was made up of the posterior sheath of the rectus abdominis muscles bilaterally. The floor and lateral wall of the cyst were made up of fat and peritoneum which formed the falciform ligament of the liver. (Fig. 2.)

The entire inflammatory cystic wall was excised and the cavity closed with interrupted catgut sutures. The fascia of the rectus abdominis muscles was closed. The postoperative course was uneventful and the patient recovered without further symptoms.

The pathologic examination revealed that the abdominal cyst had an irregular, congested, thin, blue, serous lining. The outer surface was smooth and moderately hemorrhagic. The microscopic examination revealed irregular, hyalinized, laminated fibrous tissue with scattered areas of hemorrhage. In one field a stratified epithelial layer was apparent and showed moderate infiltration by round cells and polymorphonuclears. Infiltration by round cells and polymorphonuclears was apparent also in other fields. The findings indicated a serous-lined cyst with mixed acute and chronic inflammatory reaction.

The etiologic factor of a cyst in the falciform ligament of the liver is the failure of the left fetal umbilical vein to obliterate. The residuum of the fetal left umbilical vein normally forms the ligamentum teres hepatis after obliteration but may become cystic if the normal process fails.

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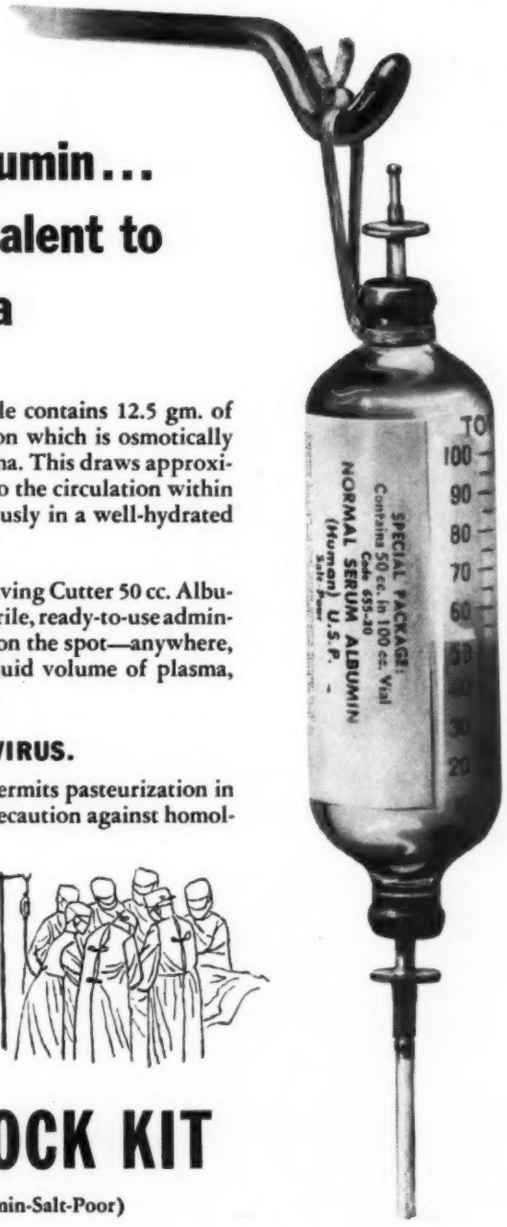

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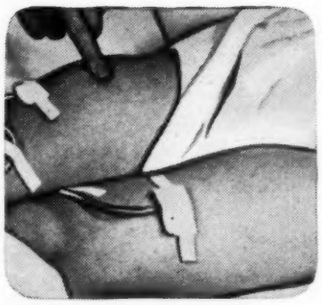

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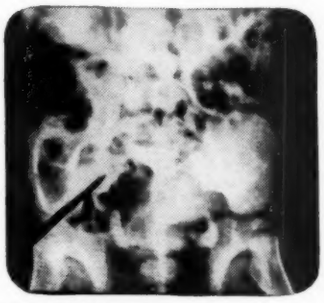

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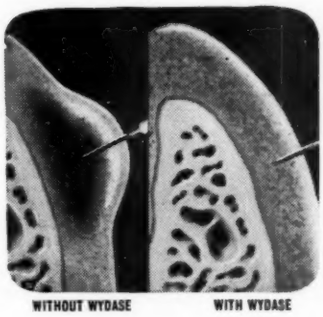

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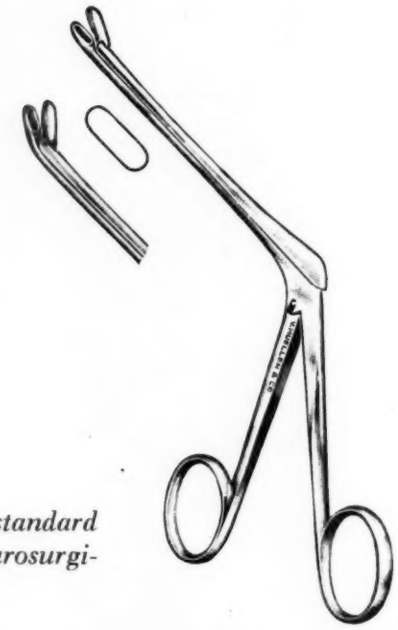

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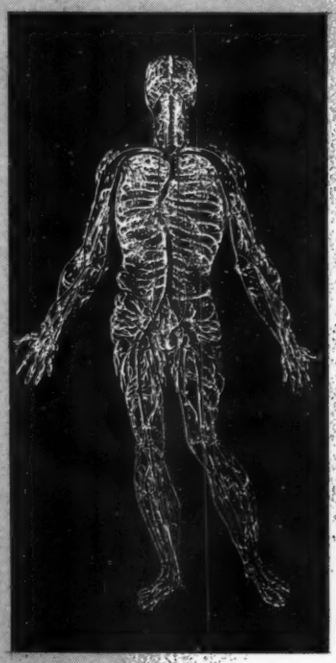

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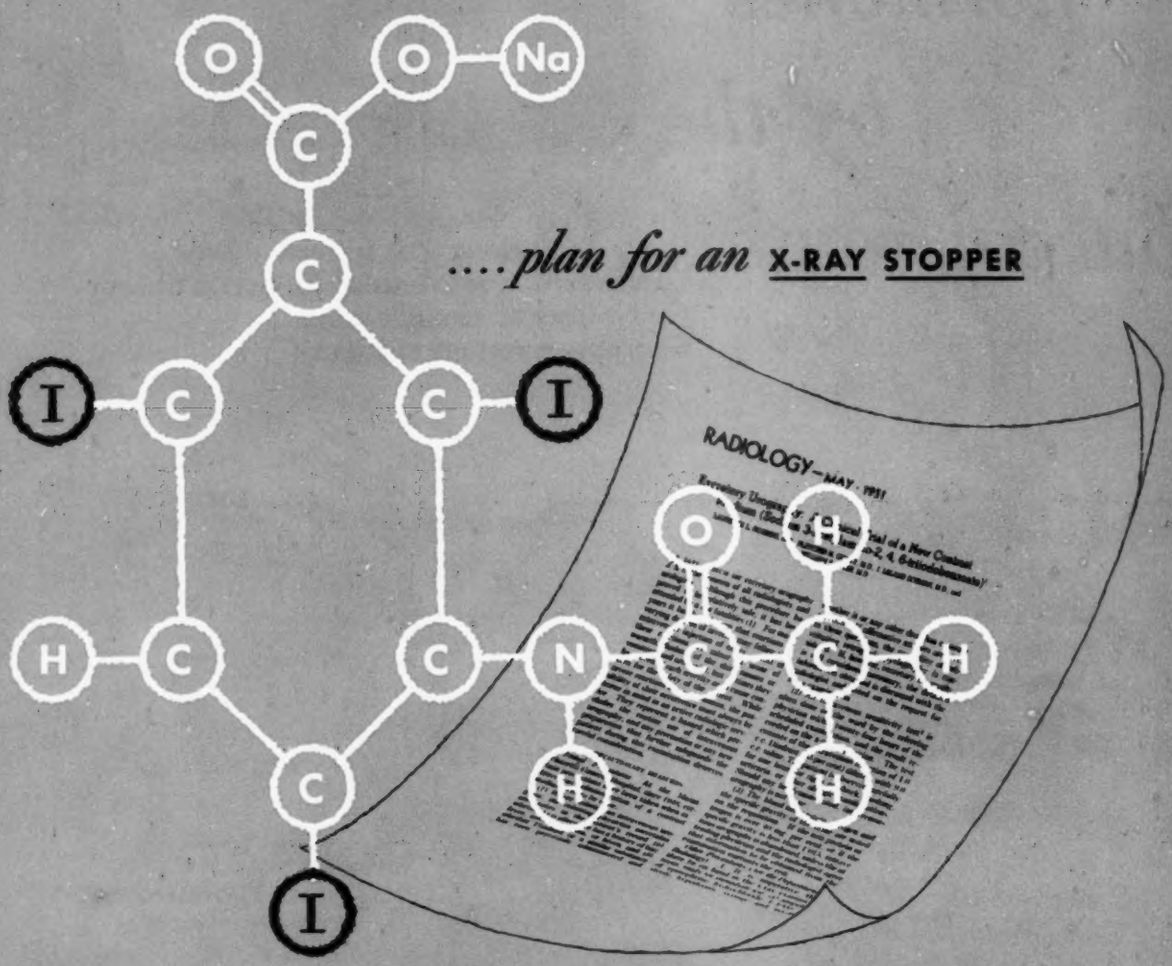

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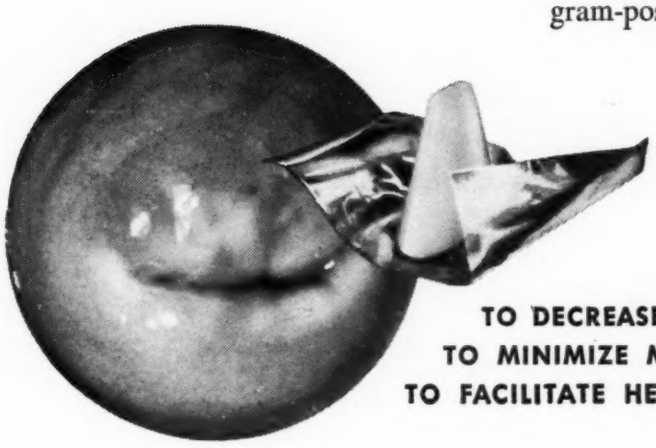

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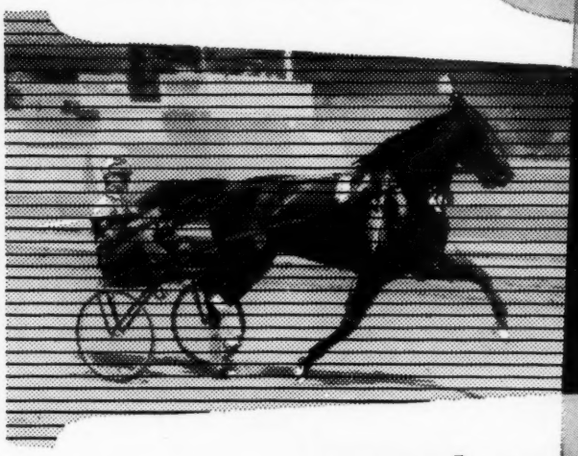

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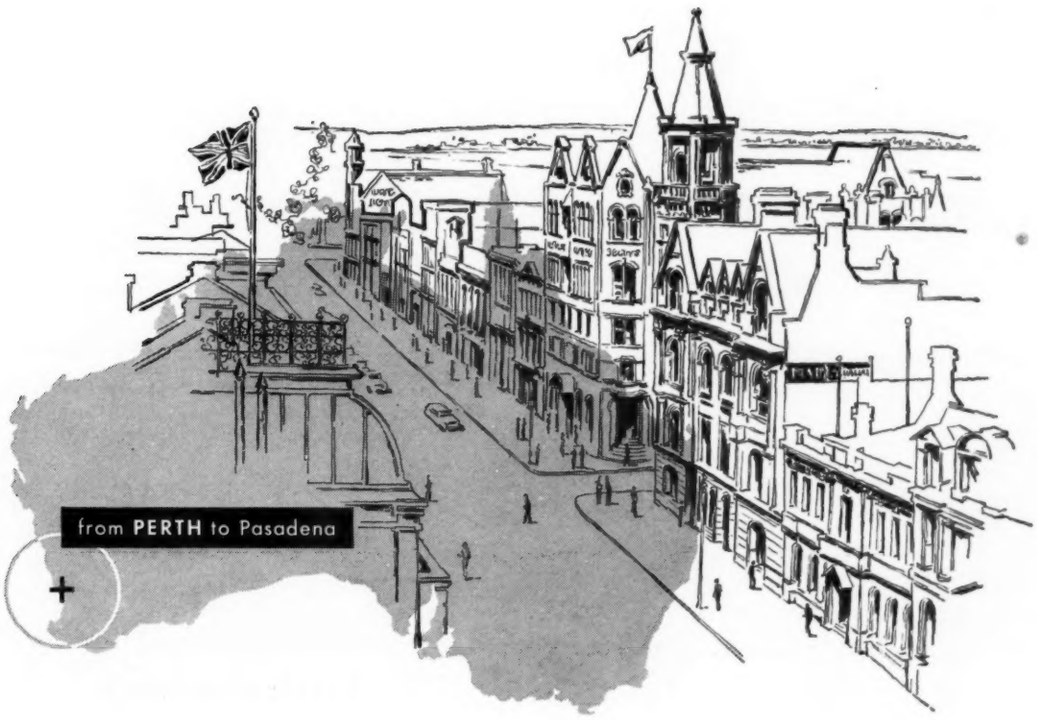

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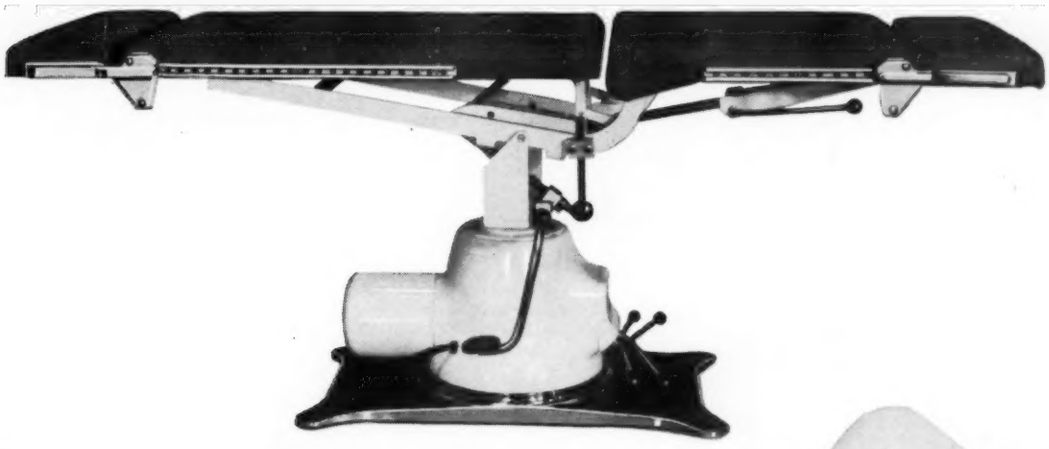

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*Morrison, L. M.: Arteriosclerosis: Recent Advances in the Dietary and Medicinal Treatment, J.A.M.A. *145*:1232 (Apr. 21) 1951.

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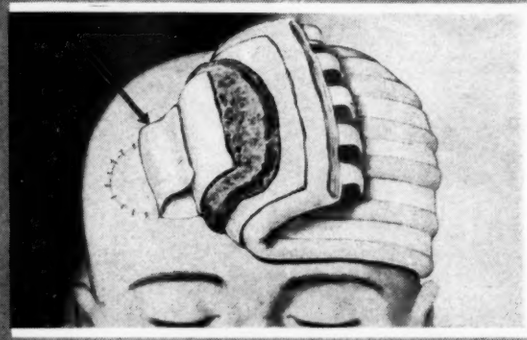

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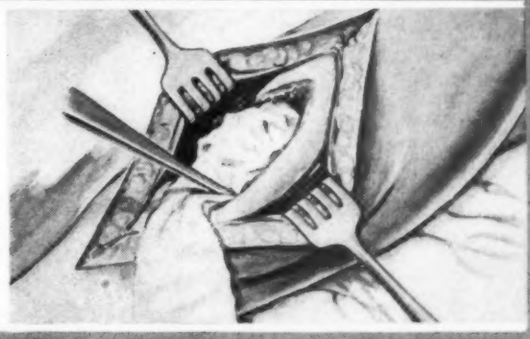

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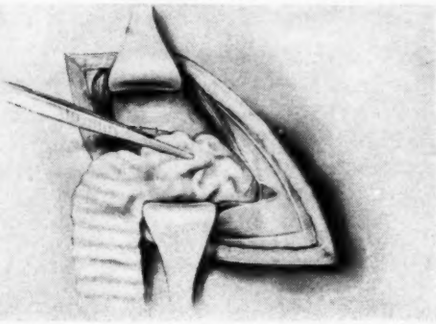

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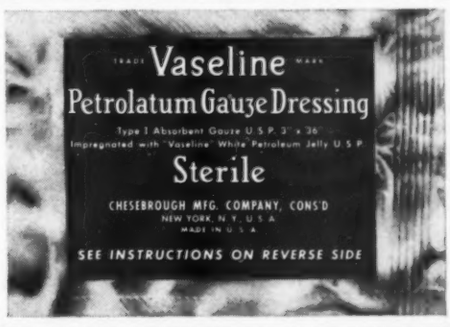

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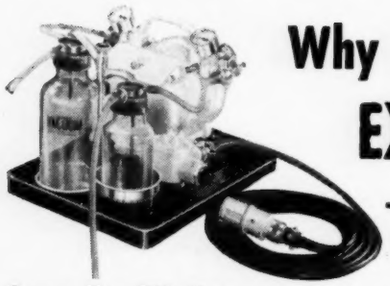

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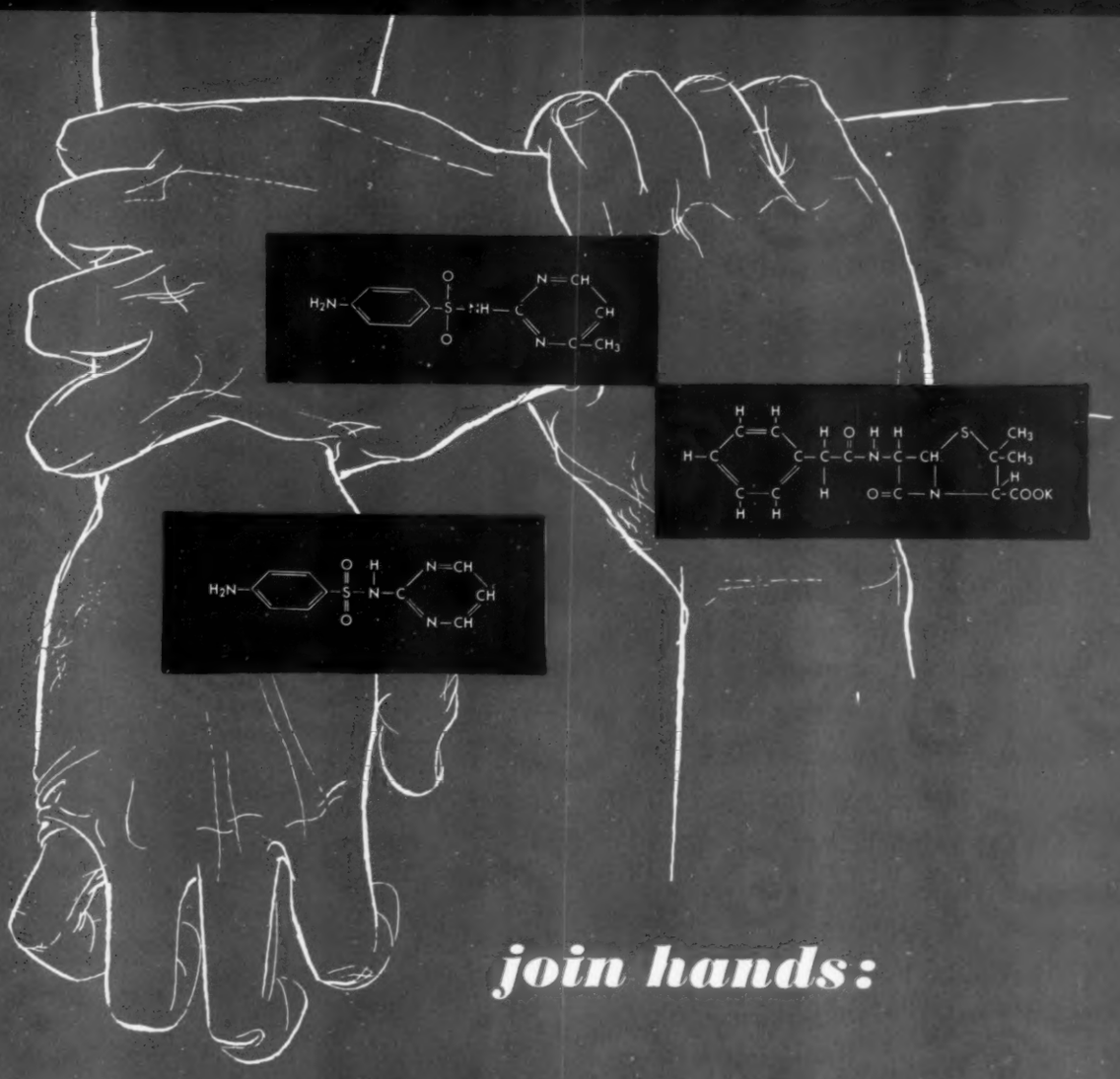

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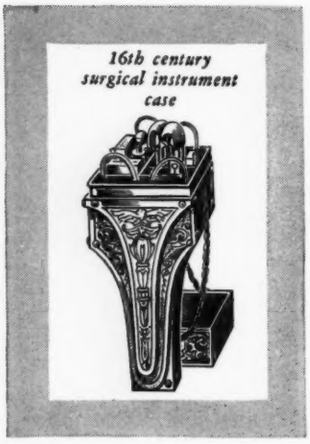

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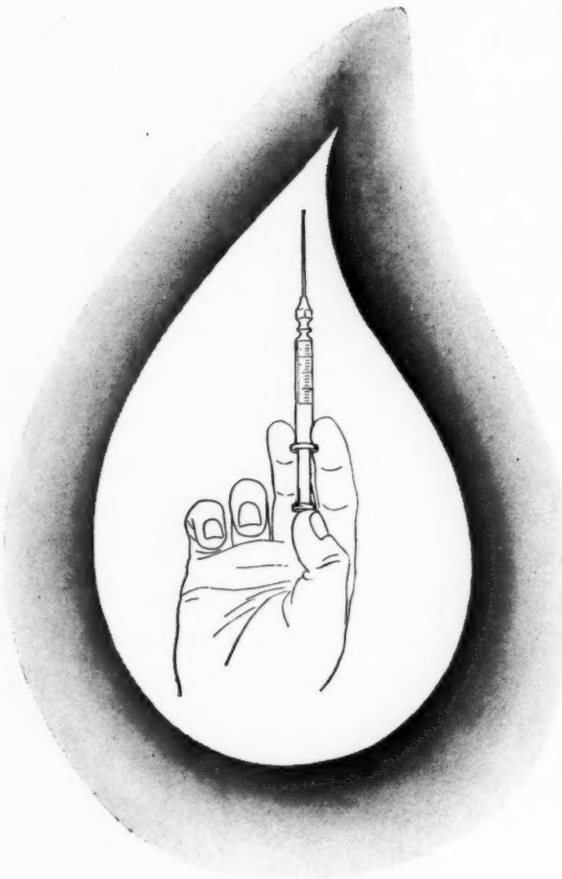

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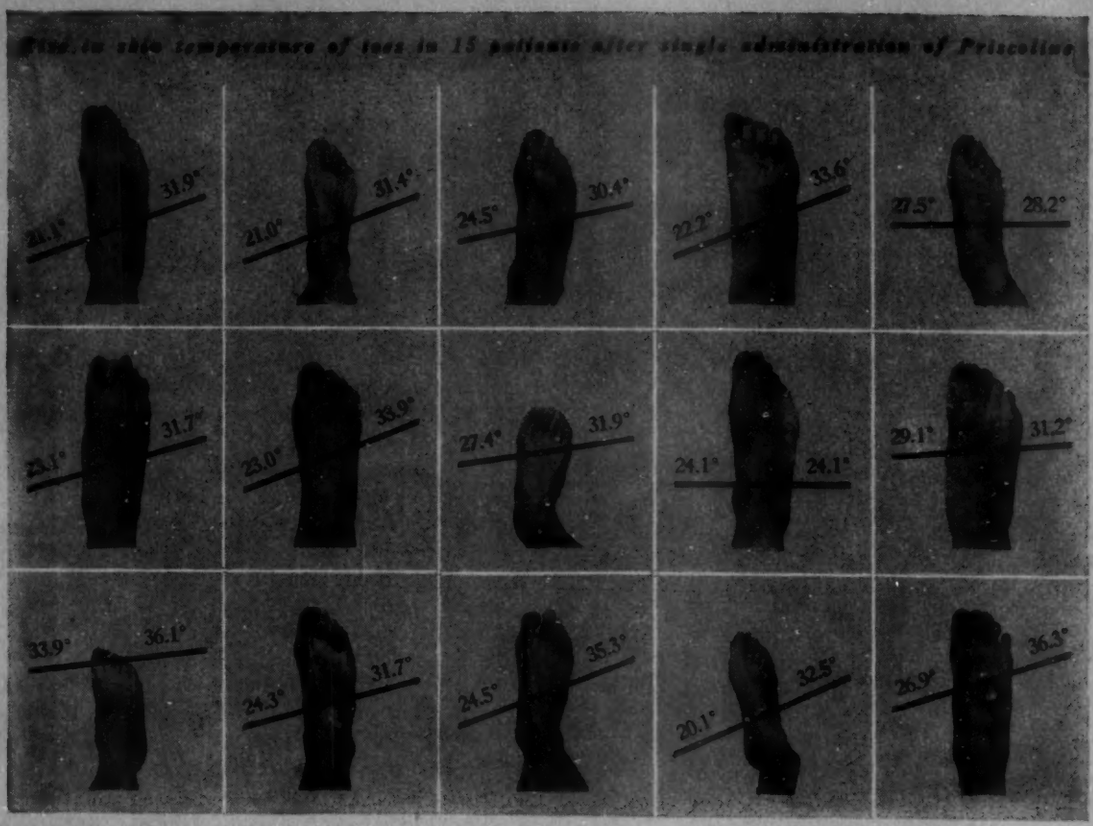

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